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AMERICAN MACHINIST

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The Stiles New Toggle-Joint Drawing Press.

The accompanying illustration shows a press for drawing sheet metal, recently brought out by the Stiles & Parker Press Co., Middletown, Conn.

In designing this press, the plan formerly pursued, of employing cams upon the crank-shaft for the purpose of forcing down and holding the blank-holder, has been abandoned, and in its place a toggle joint movement is used, which is so constructed that when the pressure of the blank-holder is fully brought on to the blank, all strain due to that pressure is taken off the crank-shaft, and transferred to parts composing the toggle mechanism, all the working parts of which, as soon as the full pressure is attained, cease their motion and remain at rest during the "dwell" of the blank-holder, and are consequently not subjected to the wear which inevitably results from any movement of the working parts under such tremendous pressure as is necessary to hold a large blank while being drawn.

For the benefit of those not familiar with this class of machinery, which is little used outside of certain manufacturing lines, it may be interesting to state that it is with such machines that the numerous forms of hollow sheet metal ware, and ornamental articles, tinware, granite ironware, brass goods, lamps and fittings, clock cases, silver and britannia ware, etc., are drawn and pressed into shape without joints or seams from the flat sheets of the material. It is by the use of such machines, probably more than any other one cause, that such goods are produced with such marvelous exactness and elegance of form, and at such low cost.

It will be noticed by reference to the engraving that there are two slides or plungers, one working within the other. The outer one is called the blank-holder, its purpose being to first descend and press the outer portion of the blank firmly to the face of the die, and it then remains stationary, exerting a heavy pressure upon the blank, while the inner plunger or punch descends and presses the center of the blank into the die, forming the shape desired.

Heretofore the practice has been to employ cams upon the crank-shaft which gave motion to, and caused the pressure upon the blank-holder, and to afterward raise it by the action of a spring, a counter-weight, or similar device.

It has been all along recognized that this plan was open to objections, some of which are, that as soon as the full pressure is brought to bear upon the blank-holder by the cams, the crank-shaft upon which the cams are fitted, must revolve with this full pressure upon the face of the cams, and consequently, of course, upon the bearings of the shaft. This produced a rapid and uneven wear in those bearings (since this pressure was exerted during a part of each revolution only) and, since the cams were in motion over the rolls during the entire time of the maintenance of this pressure, they were worn away, and the pins upon which the cam rollers turned were rapidly worn.

Another difficulty was that when the cams had brought the blank-holder down, and put upon it the required pressure, the plunger, or drawing action commenced, and since this was effected by the same shaft, the increased, strain upon it, caused it to spring slightly and thereby partially relieve or decrease the pressure upon the blank-holder, just at the time when it is important that that pressure should be fully maintained. This is the origin and cause of the "top wrinkle" so often seen in deep drawn articles, and which it is, of course, desirable to avoid.

An essential feature in doing such work is the placing upon, and maintaining a uniform pressure upon the blank during the process of drawing, and a failure to secure this, often makes it necessary to use metal of greater thickness than would otherwise be needed, in order to stand the unequal strain, or more operations have to be resorted to for finishing the article. This is especially noticeable in working the thinner metals, in which case the slightest variation or lack of uniformity in blank-holding, will often result in breaking the metal. The small amount of wear upon the cam faces, which can take place without seriously affecting the uniformity of the blank-holding, will be apparent when it is remembered that metal of No. 31 gauge is often drawn, in which case a wear of .012" would equal the entire thickness of the blank.

In designing the press here shown, the object has been to avoid these difficulties and produce a press in which as little wear and yielding under pressure shall take place as possible, and to so arrange that what wear does take place, shall have the least possible injurious effect upon the action of the machine.

Upon the upper part of the plunger are two rollers, one on each side, which work in the cam tracks formed in the upper members of the toggle joints. These cam tracks are so formed that when the plunger starts to descend, by the action of the crank and connecting-rod, the blank-holder is made to descend ahead of it until it presses upon the blank, with the required pressure; at this time the toggle joints are straightened, their three working centers being in the same vertical line, and at the same time the lower portion of the cam track is in a vertical line and parallel to the motion of the plunger, so that there is no further motion of the toggles, and little or no strain upon the rollers or cam tracks, the strain arising from the pressure put upon the blank having been transferred to the members and pins of the toggle joints and the frame of the machine, none of the parts under this strain being in motion during the "dwell" of the blank-holder.

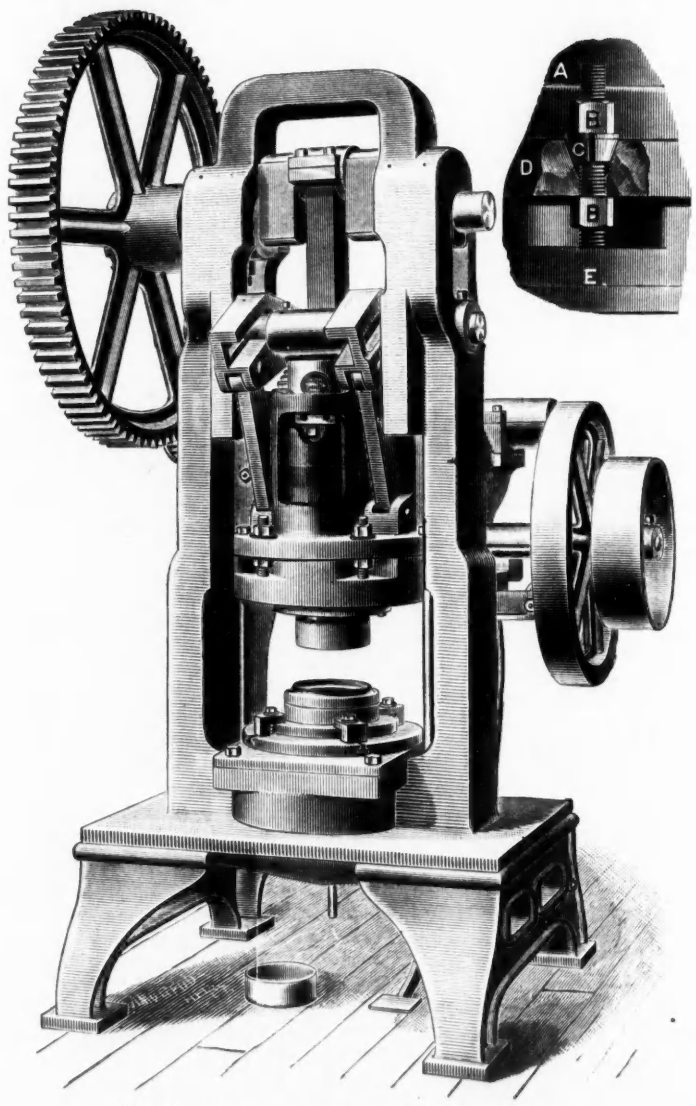
It will also be noticed that the slides of the blank-holder and of the plunger, the die in which the work is done, the upper and lower centers of the toggle joints, and of the crank-shaft are in the same straight line, thus avoiding all tendency to "cramp" the slides and produce side strains, and also that the main frame, which must resist these strains follows the same straight line, thereby securing the greatest possible rigidity.

It will be seen that, by this construction, no more wear or strain is imposed upon the moving parts than is necessary for the work they have to do, and that it is well nigh impossible for any wear to take place which will at all affect the uniform pressure of the blank-holder. Also that the movement of the blank-holder, being controlled directly by the movement of the inner slide or plunger, precludes the possibility of their getting "out of time."

Another new feature of importance is in the manner of adjusting the blank-holder so as to bear evenly all round the blank, without the necessity for "packing" the dies. For this purpose the blank-holder plate proper (*E* in the small cut) is supported by three or four large screws, which can be adjusted separately, without any tendency to cramp the movement of the slide in its bearings. The conical split nuts *C* adjust themselves to any angularity in the position of the screws which may become necessary in order to produce an even pressure all around.

The punch is easily adjusted by means of a large screw in the inner slide, which is prevented from getting loose or turning out of place, by a new device, dispensing with jam-nuts.

These presses are made in fourteen sizes, weighing from 1,000 to 60,000 pounds, the smaller sizes as fly-wheel presses, the larger ones geared like the one shown, and furnished either with the Stiles Positive Stop Motion, or with an improved friction clutch, controlled and operated by the foot in connection with a friction brake, so that the motion can be stopped, held and started at any part of the stroke.



THE STILES TOGGLE-JOINT DRAWING PRESS.

A Tool for Under Planing.

No one who has ever had much planer work to do on the under side of surfaces, such as the projecting parts of lathe beds, which must be planed for the carriage gibs to work on, will fail to appreciate the tool for that purpose, devised and used in the Springfield Machine Tool Co.'s shops at Springfield, Ohio. It not only obviates the necessity for standing by and lifting the tool, and holding it up during each back stroke, which is always a very irksome pastime, but lessens the liability to accidents, and in the end reduces the cost of tools.

As will be seen by the sketch, page 2, it consists of a square shank held under the tool clamps of the planer in the ordinary manner, and having its lower end enlarged and a hole bored through it for the reception of a shaft, which, at its outer end, carries the tool, as shown held in place by a set screw.

The shaft is a good working fit in the bar, and is made to turn slightly in it, its motion being limited by the short pin which is driven into the collar of the shaft, and enters the circular slot milled in the side of the bar, as shown. When the tool strikes the cut the pin is forced up to the end of the slot, as shown, but during the back stroke the small spiral spring inserted in the slot behind the pin allows the shaft to turn back sufficiently to relieve the tool, restoring it to its place again before the next cut commences. With this tool the clapper can be clamped down, and the work proceed with all the convenience and comfort attending the doing of any

other kind of planer work, and without the fear of the tool catching and wrecking something. And on account of the tools being so much easier and more simple to forge and grind than the ordinary hook tools used for this kind of work, it will probably prove cheaper in the end to use this new device.

It should be made entirely of tool steel for the sake of rigidity, and if made in the form shown, it would be necessary to have two of them (or at least two bars), one for right and the other for left-hand work. But if the projection or hub be left off the side of the bar, and a slot milled in each side, the shaft can be taken out and put in from the opposite side, and it will then work either right or left-hand, but this, of course, would shorten the bearing of the shaft in the bar and be at the expense of stiffness, besides being more trouble to rig up.

There are no restrictions upon its use by any one who chooses to make one, and we think there are many shops where it would pay to make and use them.

A New Friction Clutch.

The accompanying engraving and outline cuts show the construction of a friction clutch which possesses some features of novelty and interest.

Fig. 1 shows the general arrangement of the parts detached from pulley arms, nothing being shown but the essential parts of the clutch itself.

It will be seen to consist of the usual sliding collar moved by the shifter, and carrying a wedge-shaped piece (*P*, Figs. 2, and 3), the straight side of which slides in contact with a shoulder on the fixed collar or hub of the clutch. The opposite side of the piece *P*, when it is moved forward, comes in contact with and moves the end of a lever (*A*, Fig. 2), which is pivoted at the center *B*, the other end of the shaft upon which it turns, carrying the two pins *D* and *C*, to which are attached the ends of a steel band which encircles the friction surface. This surface is cast-iron and the steel band is faced with leather on the inside.

The lever is in two parts, the part which comes into contact with the wedge *P*, not being fastened rigidly to the shaft *B*, but is held in place by a bolt which passes through a slot and is tapped into the other part of the lever, as shown. By loosening this bolt and turning the set screw, the ends of the two parts of the lever can be separated to any desired extent, and as the part which carries the set screw is fast to the shaft *B*, it will be seen that this affords a means of adjusting the clutch. A flange prevents the friction band becoming displaced when the clutch is released, and the weight of the lever and its attachments are counterbalanced as shown.

It will be seen that the construction and operation of the clutch is very simple, and that the adjustment being made by only one screw, it is impossible to so adjust it as to obtain other than an even and uniform action.

They are made for lathe and other countershafts up to 16″ diameter, 4″ face, clutch couplings up to 30″ diameter, or larger to order, and friction clutch pulleys up to 54″ diameter, 20″ face, by W. Oesterlein, 137 W. Second street, Cincinnati, Ohio.

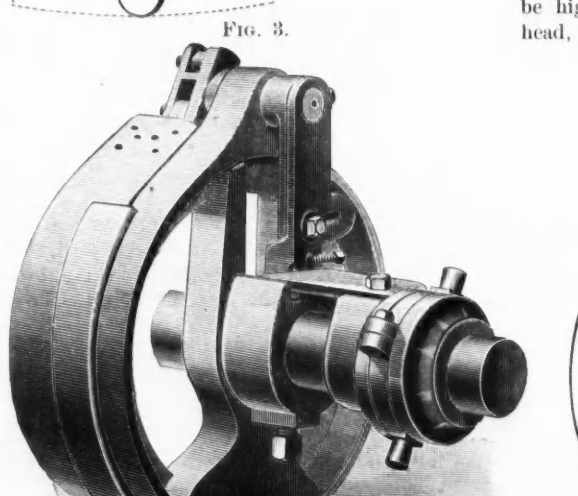


Fig. 3.

Fig. 1. Friction Clutch.

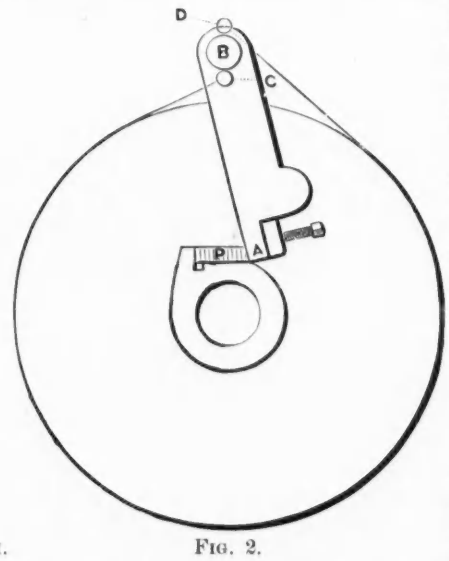


Fig. 2.

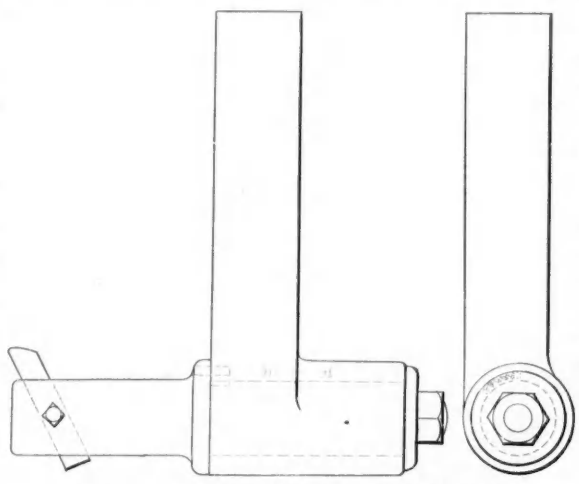
Design, Construction, Repairs and Management of Marine Steam Engines and Boilers.

By W. H. Hoffman.

TENTH PAPER.

The next important detail of the main transmission is the piston-rod. Of the several methods of fastening a marine engine piston-rod to the crosshead, the taper end with nuts or with a round edged cross key, are the two best, all things considered. The writer believes, however, that the piston-rod and crosshead should be forged in one piece, and thus secure perfect safety. To make a perfectly sound forging is not an easy matter, but this result can be reached, with a little more than an ordinary amount of care.

The first thing to be looked after is the design of that portion of the piston-rod that joins the upper part of the crosshead. To explain the form of this junction we will take our piston-rod, and crosshead as an example. The piston-rod is 5″ diameter in the body, and the crosshead portion is 8¼″ thick. Now 7¼″ would be thick enough for this crosshead, as the cap bolts will be only 3⅜″ diameter. The usual rule is to make the crosshead jaw twice as thick as the diameter of the cap bolts. This thickness, however, does not permit of a good union in the forging, hence the extra thickness adopted in our case. The difference between the diameter of the rod, and the thickness of our crosshead jaw is 3¼″, or 1⅝″ on each side. In this latter distance we form the curve of the parabola, starting quite at the edge of the crosshead, and finishing the curve 5″ above. This form of neck will prevent undue strains while the forging is cooling, and provides for a homogeneous union of the round piston-rod and rectangular crosshead jaw. The sectional area of this point of the union is 53 square inches, which is more than double the area of the body of the piston-rod, and 25 per cent. more than the cross-section of the central portion of the connecting-rod. Nothing can be more secure than this arrangement of a combination forging, and it is now used by some of the best marine engine builders for nearly all sizes of engines.



Tool for Under-Planing.—See Page 1.

The jaw opening for the boxes for the crosshead pin will be 12¾″ wide, and the whole width of the crosshead between the inside faces of the gibs, or shoes, will be 32″. The distance between the faces of the guides will be 38″. The depth of the jaw in a vertical line will be 14⅜″, the lower half of the crosshead pin box projecting ⅜″ where it meets with the cap. The thickness of metal above the jaw opening will be 1½ times the diameter of the body of the piston-rod, or 7½″, making the total depth of the crosshead portion of the combination forging 21⅞″. The crosshead gibs will be ½ the length of the stroke, or 27″. To lighten the crosshead forging as much as possible there will be openings cut all the way through on each side of the pin jaw, leaving a thickness of 6¾″ on the sides, 3¾″ on the bottom, and 21½″ on the top. The corners of these two openings will be well rounded to, say, a 2½″ radius, and finished the same as the outside of the forging.

The cap bolts for holding the crosshead pin boxes in position will be tee headed, and will be planed into the inside faces of the jaw. They will be 3⅜″ square in the jaw, and 3⅝″ round where they pass through the cap. From the lower side of the crosshead to the lower side of the tee head will be 8″. The cap bolts will have two nuts, each 3½″ thick, and the bolts will be 3½″ diameter at the thread. The gibs will be proportioned to carry 50 pounds' pressure per square inch, and will therefore be 12½″ wide; thus leaving a projection of 2⅛″ on each side of the jaw.

Between the back of each gib and the ends of the crosshead proper will be fastened a piece of lignum-vitæ 1″ thick, and the wedges for setting out the gibs will lay against these pieces of hard wood. The lugs on the wedges for adjusting screws will be on the upper side, and will be high enough above the crosshead, to allow a spring 3½″ long, to be placed under each lug. The object of these springs is to take the entire weight of the wedges, so that when the check nuts on the tops of the lugs are slackened, the wedges will instantly rise automatically, and relieve the pressure. The lower ends of the gibs will be fitted with a brass clip to carry the oil brush, and the top ends will have a pipe stand and pan to reach the automatic sight feed oiler. The gibs will be of phosphor bronze, of skeleton design, and fitted with white metal staves that can be removed with the crosshead in position. Two duplicate sets of these white metal liners should be among the engine-room stores. Immediately back of the lignum-vitæ blocks there will be a beveled face planed on the crosshead, on a taper of 1¾″ per foot, and the adjusting wedges will be fitted to these faces, the thinnest portion of the face being 2¼″.

The wooden blocks answer two purposes; they prevent in a great measure the shocks (caused by loose gibs) from reaching the piston-rod, and also prevent the heat of the steam transmitted by the piston-rod from reaching the gibs.

The method of fastening the piston to the rod is a point to be well considered. Any device that is liable to jar loose will, of course, endanger the whole structure. Some builders still use the old cross key, but I think the threaded end with nuts is far better. The piston fastening must be of a design that will allow a ready removal in case of accident, without injury to the piston-rod. One of the best methods used by the writer consists of a split cone bush fitted to the piston-rod on a long straight bearing, bringing up on the lower side against a shoulder on the rod.

The split cone is turned on its outer surface to a taper of 1½″ per foot, and as the pressure of the piston-rod nuts is brought to bear on the piston, and thence to the split cone, it is compressed against the piston-rod and grips it with great force. The portion of the piston-rod passing through the split cone is turned to a diameter of 4¾″, leaving a shoulder on each side of ½ of an inch, and this shoulder is rounded to the body of the piston-rod. The diameter of the upper threaded portion of the piston-rod will be 4⅝″, cut 3½ threads per inch. The lower piston-rod nut that rests on the piston-head will be 4⅞″ thick, and will have a cylindrical check; while the upper nut will be but 3½″ thick, and will have no check ring. The diameter across the flat portion of these hexagon nuts will be 8⅜″, and the lower check ring will be 10¼″ diameter, and 2⅜″ deep.

The split cone will be made of mild forged steel, and will be cut through on one side, leaving a slot 5/16″ wide to allow for the closing action when the pressure of the nuts is applied. The diameter of the outside of the split cone, at the small end, will be 5⅛″ and 8¾″ at the large end. This agrees with our rule for the taper of the cone, as our pistons will all be 13½″ deep at the center, but only 8¾″ deep on the edges. For a thickness rule for pistons for triple expansion engines, we take one-fifth of the diameter of the low pressure cylinder for the depth of all of the pistons at the center, where rod passes through them. We make the pistons of the same thickness, and the cylinders of the same length; first laying out the proper length for the low pressure cylinder.

This method of securing a steam piston to its rod ensures, besides great strength, the closest accuracy. The cost of fitting is but little more than the usual arrangements, and the actual work of making the attachment is much less than any of them. It enables us to use a small piston-rod, and still have a blunt taper to draw against. Should the cone be injured by removal or any kind of handling, it can easily be re-turned without wasting the strength of the piston-rod proper. It has a very large fitting surface, and therefore holds the piston firmly and steadily in line with the bore of the cylinders; a most important matter in a high speed marine engine.

We have now described the four main parts of transmission; the crank shaft, connecting-rod, cross-rod, and piston-rod.

Fourteen-Inch Engine Lathe.

The engraving presented herewith represents a new 14 inch by six foot engine lathe, made by the Hendey Machine Company, Torrington, Conn. The general construction of the lathe may be seen in the engraving.

The spindle is of hammered steel, running in hard bronze boxes. The front bearing is 2 inches diameter and 3⅞ inches long; back-bearing 1½ inch diameter and 2½ inches long. There is a hole through spindle 1 inch diameter.

The gearing in head is 13 to 1; cone diameters 8½, 6⅞, 5¼ and 3⅝ inches, for 2 inch belt.

The lathe has raise and fall rest, and takes in 3½ feet between centers.

The countershaft has pulleys 9 inches diameter and 3 inch face, and should run 190 revolutions in forward and 225 revolutions on backing motion. Longer beds are furnished when wanted.

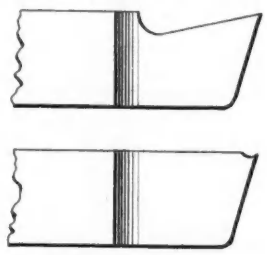
The screws and gearing provide for cutting screws from 2 to 48 threads per inch.

About Cutting Tools—An Item Not Always Thought Of.

BY FRANK H. RICHARDS.

If topics were apportioned in the mechanical journals according to their relative importance to the trade and the promotion of its successful practice, we would have more about the shape and use of cutting tools, even if we had a little less discussion and repetition of methods for computing change gears on the lathe, setting the slide valve, constructing upright drills, etc. I need not say that the shape, adjustment and permanent maintenance of the condition of cutting tools is one of the most important things that can engage the attention of the practical machinist. It occurs to me to call attention to one point about which, so far as I know, little has been said, but which is of some importance and worthy of consideration. I mean the shape of the cutting tool as affecting the action of the chip after it is actually cut; the propriety of considering the chance the chip has to get away in the easiest and most natural course, and when not flowing away without resistance the reaction of this resistance upon the operation of cutting and upon the condition of the surface cut. It may surprise the thoughtless, but all the same it does make a difference in the cutting, how, after the chip is cut, it gets away from the work. I mean to say that, without the slightest alteration of the cutting edge of the tool by changing the shape back of the cutting edge, the action of the chip can be changed, the resistance it encounters can be increased or diminished perceptibly, the amount of power required to do the same cutting may be changed, also the condition of the surface cut and the endurance of the tool. I think I am backed in this by my experience and observation. Any machinist may try it by taking two cutting-off tools, alike in every particular except the one, and cutting in to a good depth on a clean piece of steel or wrought-iron. Have the clearance the same on the sides of each, and have the tool set so that the clearance will be equal on both sides. Have the bevel of the front the same on both, and have the angle of the cutting edge the same, but let the top run back in a straight line on the one, and let it run into the detestable little circular groove on the other.

I have spoken before, once or twice in print, and one or two thousand times with my voice, about this contemptible little circular groove—never mentioning it without an adjective—which the impatient and thoughtless machinist is in the habit of grinding on the cutting face of a tool to give "cut" to the edge. The most prevalent and costly vice of the machine shop, the little bad habit with big and costly bad results, is the careless and ignorant grinding of tools, and the exasperating little round groove is the vilest manifestation of it. Whatever the metal to be cut, there is always a shape that is best for cutting it. It is the machinist's business to know the best shape, approximately at least. And it is his business not merely to know that best shape, but to insist upon having and using it. It is furthermore the machinist's business to maintain that shape right as much as it is the carpenter's business to keep the shape of his tool right after successive grindings. Now, no one who grinds the execrable little circular groove at the cutting edge of the tool is either giving it the best shape for the present or arranging for a maintenance of that shape in the future. Take the two tools sketched here; one can be ground back ½" and still be all right, but how can you grind the other back as it wears and maintain the cutting angle? It can be carried



CUTTING TOOLS.

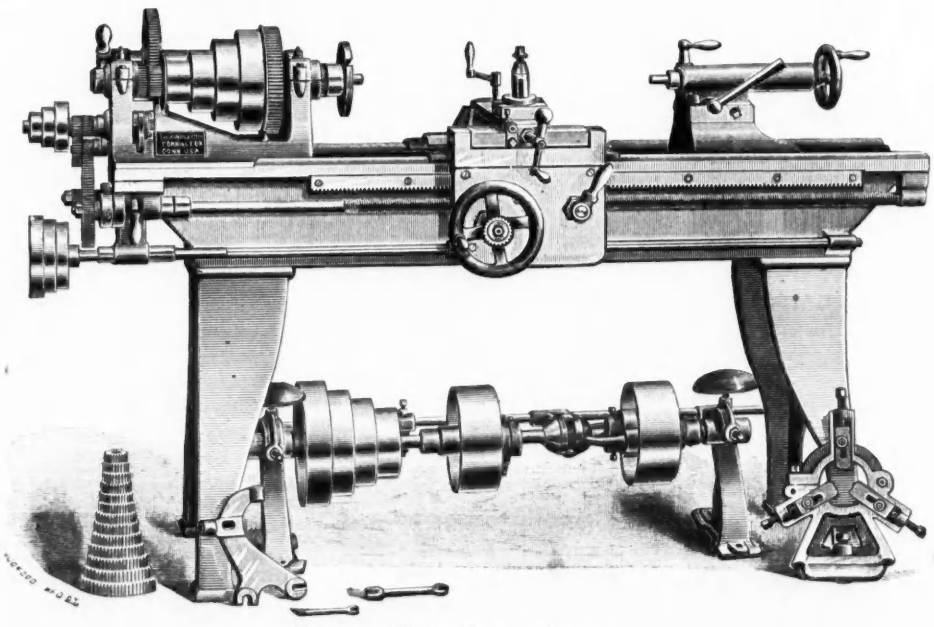
to the blacksmith half a dozen times, and then not accomplish what the other tool would do in competent hands. If I have apparently insinuated that laziness is the motive—though laziness is of course a brake instead of a motor—that leads a machinist to mutilate a tool by grinding the diabolical circular groove upon the face of it, I hereby retract and apologize. In many cases he not only does not know any better, but evidently actually believes there is virtue and magic, and all helpfulness, in this device of the evil one. How else can I account for the fact that, not long ago, I actually found a diamond point disfigured with this confounded little circular gutter at the cutting edge of it? I am confident that the poor simpleton who ground it—I don't know who it was—thought he was doing a glorious thing when he did it. It took a great deal more trouble than it would have taken to grind it in the legitimate way. One of the sterling virtues of the glorious and venerable old diamond point is that it insists upon having its cutting angle formed of three flat or nearly flat surfaces. It does not voluntarily lend itself to any nonsense in grinding. The prevalent vice in grinding the diamond point is in not grinding the faces uniformly all over, and thus maintaining the original planes and the original angle they form. With many machinists that I have seen grind, or rather regrind tools, I should judge that there was not the slightest attention given to the preservation of the correct shape, but only a determination to remove the wear and leave some kind of a sharp angle at the least possible expenditure of effort.

A little experience I had with this particular diamond point brings me to say, what I set out to say at the beginning, that, to secure the best results in cutting metals, provision must be made in the shape of the tool for getting the chip away from the work with as little strain and hindrance as possible after it is cut. This diamond point I tried first with the hateful little round groove at the cutting edge as I found it, and it did not work very well; as I did not expect it would. Of course I was prejudiced against it, and I had a right to be. If I were not able to prejudge some things mechanical it would mean that I was at the beginning of everything. A man without prejudice is an inexperienced fool. But notwithstanding my prejudice I gave it a fair chance. I set it as correctly and advantageously as I could, and started to take a cut over a piece of soft steel. As I said, it did not work to suit me at all. The surface of the work was left rough and ragged, the chips rolled up tight and broke into little pieces as fast as they rolled up. I took the tool and ground the cutting face back flat, continuing the shape as it was at the cutting edge, but without changing or touching the edge. Then I replaced the tool as before, and started the lathe with the same cut. The chips that before rolled up tight and broke up into little bits, flowed away in a handsome and continuous ribbon, the surface turned was much smoother than before, the work sprung less, the lathe evidently worked easier.

Not merely the top of the lathe tool, but the cutting side, should also usually be flat. The chip must roll up as it is cut, to be able to get out of the way, and the flat-sided tool cuts a flat chip or ribbon that rolls up easily. A round-nosed tool cuts an arched chip which can only be rolled up by continually breaking as it rolls, costing more power to drive the lathe and putting more friction upon the tool, causing it to heat up and wear away faster.

The tools used upon big lathes and planers are especially worth looking after, because the malformations are more frequent and the consequences more costly. On account of the difficulty of grinding heavy tools the tendency is generally to use them with curved surfaces, and with lips formed by a blacksmith's fuller, leaving a trough into which the chip plunges at a very abrupt angle, and in the case of a heavy chip, costing much power to roll or break it away. It is worth while to inquire into the subject. I think it quite possible to surprise some good mechanics by showing them how much power it sometimes takes to get a heavy chip out of the way after it has been well cut.

I would like to illustrate the subject more fully, but I find it difficult to satisfy myself with sketches of lathe tools.



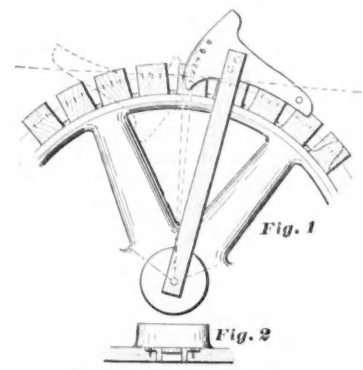
FOURTEEN-INCH ENGINE LATHE.

Making Gear Patterns.

BY P. S. DINGEY.

There are so many ways of making gear patterns that it would be extraordinary to show some new way. The question is, which is the best way to make a gear pattern to stand a reasonable amount of hammering, not be unnecessarily expensive, and so that a casting when taken from it will run smoothly.

Even on a gear pattern much unnecessary time may be spent, and is spent, that does not make the pattern any better, but only more expensive. For instance, dovetailing the teeth on gears 1½" pitch and above is unnecessary work. Much time can be saved by fastening teeth on, as shown in Fig. 1; I find this way is cheaper and by no means inferior to dovetailing. It is often found, after turning the rim, and the teeth dovetailed on, that the wheel does not run true; and yet there are men who argue that a gear cannot be made right unless the teeth are dovetailed on. By the method shown in Fig. 1 we have the advantage of getting a fillet at the root of the tooth, which cannot be well made on a tooth that is dovetailed on. The tooth



MAKING GEAR PATTERNS.

is also strengthened and made better for moulding, which means a better casting.

In making the pattern, all the blocks for the teeth should be sawed out first, and allowed to stand, also the segments for building the rim. Then get out the arms and merely finish them; build them in the rim when it is built up half way. Turn out the center of arms to receive an iron flanged bushing, as shown in Fig. 2. This bushing is made to permit of using different size hubs; it also strengthens the arms, being secured by a screw in each arm.

The rim being turned, fit and from the inside of rim, screw on blocks for the teeth; then fit strips between, as shown. These strips should be fastened in with glue and nails, taking care not to allow any glue to get between the blocks and strips, because the blocks have to be taken off again to work the teeth out. In some cases it may be better to screw on a block and fit a strip the right width against the side, before screwing on the next block, but this is purely a matter of choice with the workman.

Setting the teeth off is another point of controversy. I have heard of some shops where the teeth are laid out "to suit the eye." Of course this is entirely wrong, and though such gears may work, there will be undoubtedly much jarring and friction, which means extra wear and tear, and loss of power.

For general purposes it is desirable to get that form of tooth that shall work with the least possible friction, and at the same time be interchangeable with any other gear of the same pitch. There are various ways of getting this. One good way is by the use of Prof. Robinson's templet odontograph. Fig. 1 represents how to apply the odontograph. The full lines show it in position for marking the face of tooth, while the dotted lines show it reversed for marking the roots. It will be seen the odontograph is screwed on the end of a rod which is moved around a center pin in hub. To locate the odontograph in proper position, "setting" tables are supplied with the instrument, which will give the graduation on the odontograph to set to pitch line.

While it is very desirable to make gears that are interchangeable, and which are good enough for all ordinary machinery, it must be acknowledged that the best form of tooth cannot be made by the interchangeable system (of course I am speaking now of the epicycloidal tooth). For some special machinery, where it is necessary to have the best form of teeth without regard to their being interchangeable, the odontograph is set differently from that for the interchangeable; herein lies the value of the templet odontograph, and I would recommend its being used, especially on coarse pitches.

A Pound of Coal.

A unit of heat is the quantity of heat that will raise the temperature of one pound of water, at or near its greatest density, one degree Fahrenheit. If we place this pound of water in a vessel, the heat of the hand will very quickly raise its temperature one degree. The unit of heat is a very small quantity, as we are accustomed to look at quantities. But this almost infinitesimal quantity of heat is equivalent to 772 foot pounds of work. That is, its expenditure is sufficient to raise a weight of one pound to a height of 772 feet.

Another way to look at this is: A pound of good coal will give off, by combustion, 14,500 units of heat. This would be sufficient to raise one pound weight to a height of more than 2,000 miles! A pound of coal is only a small lump, yet if all the heat set free in its combustion could be utilized it would do a great deal of work. The fact that we are able, in mechanical operations, to get but a small fraction of this work from the pound of coal, suggests that we must save, by looking carefully after all the sources of loss, picking up a small percentage here and there, as Nature, and an understanding of natural laws, permit.

A certain man in Oglethorpe county, who works at the trade of blacksmithing, never being blessed with a son to assist him in his shop, has a daughter who well supplies the deficiency. She wields the sledge with a grace and power that would put many members of the sterner sex to shame, and withal is described as a most attractive young woman.—*Savannah (Ga.) News.*

A Mrs. M. L. Farnham, of New Orleans, has invented and applied a "car starter and combination brake" for street cars. The description in the local papers is incomplete, but it appears that the brake winds up the starter, and that relieves the horses of the strain of starting the car. Many schemes of the kind have been devised, but we hope, for the honor of the sex, this will fill the "long-felt want."

If it is true, as reported, that the Erie railroad will hereafter use hard coal for its locomotives, it will do a good deal towards making that road popular. A view of some of the most picturesque scenery in the country along that road has been persistently ruined by smoke dense enough to be cut with a knife.

Notes on the Expansion of Steam.

By Richard H. Buel.

Sixth Paper.

The table herewith presented gives the results of the calculations for all the assumed points of cut-off, computed in the same manner as has already been explained in details for the apparent cut-off of ¼". The table also gives the analytical formulas by which the results were obtained. It will be seen that the formulas are general in their applications, and can be used for any assumed conditions of condensing and non-condensing engines with unjacketed cylinders, supplied with saturated steam. Of the 57 lines in the table 13 (1, 2, 3, 4, 5, 6, 7, 9, 11, 19, 24, 30 and one case in line 44) contain assumed conditions, intended to represent fair practice, but any or all of these conditions can be varied at pleasure, which changes will, of course, affect the other results.

It will be remembered that this calculation was started with the idea of using no theory which was not a true theory, or one which would not fairly represent the actual conditions under which well-designed steam engines are operated, and the final results, in line 57, must stand as a proof of the correctness of the theory employed, or as a refutation of that theory. Probably the figures in this line have a familiar appearance to engineers whose experience has acquainted them with the average performance of good steam engines in every-day work. In order to compare these theoretical figures with the results obtained by actual test, it will be necessary to select examples where the governing conditions (clearance, ratio of stroke to diameter, initial pressure, cut-off and piston speed) were substantially similar to the conditions assumed in the table. A few examples, selected from a large number of experiments previously published, are given in the accompanying table. They represent tests of Corliss and Harris-Corliss non-condensing engines, each engine having an unjacketed cylinder and using saturated steam; the effective power developed by the Corliss engine being measured with a friction brake, and that of the Harris-Corliss engines with a transmitting dynamometer. The conditions as to steam pressure are not as satisfactory as could be desired, and the Harris-Corliss engine had a cylinder rather out of proportion

THEORETICAL RESULTS OF USING STEAM EXPANSIVELY, WITH ALLOWANCES FOR ALL KNOWN LOSSES, NON-CONDENSING ENGINE, DRY SATURATED STEAM, UNJACKETED CYLINDER.

Item.	Symbol.	Formula.	Point of Cut-Off. Full Stroke	¾	½	⅜	¼	1-6	⅛	1-12	Number for Reference.
Effective horse-power to be developed	E	Assumed.	150	150	150	150	150	150	150	150	1
Absolute initial pressure of steam, pounds per square inch.	P	Assumed.	100	100	100	100	100	100	100	100	2
Back-pressure, pounds per square inch.	b	Assumed.	17.5	17.5	17.5	17.5	17 5	1.75	17.5	17.5	3
Apparent cut-off	$\frac{1}{r}$	Assumed.	1	.75	.5	.33	.25	.17	.125	.083	4
Absolute pressure at point of cut-off, pounds per square inch.	C	Assumed.	90	92.5	95	96.5	97.5	98	98.5	99	5
Clearance at each end, in equivalent length of cylinder, inches. Piston.	(P)	Assumed.	.3125	.3125	.3125	.3125	.3125	.3125	.3125	.3125	6
Port.	(p)	Assumed.	.625	.6875	.75	.8125	.875	1.	1.0625	1.375	7
Total.	f	$(P)+(p)$	.9375	1.	1.0625	1.125	1.1875	1 3125	1.375	1.6875	8
Piston speed, feet per minute	V	Assumed.	450	450	450	450	450	450	450	450	9
Mean absolute pressure up to cut off, pounds per square inch.	m	$\frac{P+C}{2}$	95	96.75	97.5	98.25	98.75	99	99.25	99.5	10
Apparent ratio of expansion	r	Assumed	1	1.33	2	3	4	6	8	12	11
Hyperbolic logarithm of apparent ratio of expansion.	hyp log r	From tables.	.....	.2877	.6931	1.0986	1.3863	1.7918	2.0794	2.4849	12
Mean effective trial pressure, pounds per square inch.	T	$\frac{m+C\times \text{hyp log } r}{r}-b$	77.5	75	64.2	50.6	41	28.3	20.5	11.3	13
Effective horse-power for trial pressure, each square inch of piston area.	h	$\frac{T\times V}{33{,}000}$	1.057	1.023	.739	.690	.562	.386	.280	.154	14
Trial cross-section of cylinder, square inches.	a	$\frac{E}{h}$	141.9	142.7	203	217.4	267	388.6	536	974	15
Trial diameter of cylinder, inches, to nearest quarter-inch.	d	$\sqrt{\frac{a}{.7854}}$	13.5	13.5	16	16.5	18.5	22 25	26.25	35.25	16
Trial stroke of piston, inches	s	$\frac{2\times d}{f}$	27	27	32	33	37	45	52.5	70.5	17
Fraction of clearance	F		.0347	.037	.0332	.0341	.0321	0292	.0262	.0239	18
Per cent. of clearance to nearest quarter per cent.	c	Assumed from F	3½	3½	3⅛	3⅜	3¼	3	2⅝	2½	19
Real ratio of expansion	R	$\frac{1+c/100}{1/r+c/100}$	1	1.318	1.935	2.813	3.655	5.228	6.833	9.464	20
Hyperbolic logarithm of real ratio of expansion.	hyp log R	From tables.	.....	.2761	.6601	1.0343	1.2961	1 6540	1.9218	2.2475	21
Mean pressure for stroke plus clearance, corrected for back-pressure, pounds per square inch.	M	$\frac{m+C\times hyp\ log\ R}{R}-b$	77.5	75.4	65.3	52.9	44 7	32.4	24.7	16.8	22
Mean pressure corrected for back-pressure and clearance, pounds per square inch.	n	$M-\frac{c}{100}\times(P-M)$	76.7	74.5	64.1	51.3	42.9	30.4	22.8	14.7	23
Ratio of compression. When final cushion pressure is less than initial pressure.	l	Assumed.	1	1.318	1.935	2.813	3.655	5.228	.....	.....	24
Ratio of compression. To make final cushion pressure and initial pressure equal.	l	$\frac{P}{b}$	.....	.....	.....	.....	.....	.....	5 714	5.714	25
Hyperbolic logarithm of ratio of compression.	hyp log l	From tables.	.....	.2761	.6601	1 0343	1.2961	1.6540	1.7429	1.7429	26
Final cushion pressure, pounds per square inch.	L	$b\times l$	17.5	23.1	33.9	49.2	64	91.5	100	100	27
Mean absolute cushion pressure, pounds per square inch.	k	$L\times\frac{hyp\ log\ l}{l-1}$	.....	20	23 9	28.1	31.2	35.8	37	37	28
Mean pressure, corrected for back pressure, clearance and cushion, pounds per square inch.	t	$n-\frac{c}{100}\times(l-1)\times(k-b)$	76.7	74.5	63.9	50.6	41.7	28.1	20.5	12.4	29
Probable mean effective pressure, pounds per square inch.	e	$.95\times t$	72.9	70.8	60.7	48.1	39.6	26.7	19.5	11.8	30
Horse-power for pressure e, each square inch of effective piston-area.	H	$\frac{e\times V}{33{,}000}$	.995	.967	.828	.656	.540	.364	.266	.161	31
Effective cross-section of cylinder, square inches.	q	$\frac{E}{H}$	150.8	155.1	181.2	228 7	277.8	412.1	563.9	931.7	32
Actual cross-section of cylinder, square inches for effective section q.	A	$\frac{2\ q}{2-(.018\times\sqrt{P})^2}$	153.2	157.6	184.1	232.4	282.2	418.7	572.9	946.6	33
Diameter of cylinder, inches to nearest quarter-inch.	D	$\sqrt{\frac{A}{.7854}}$	14	14.25	15.25	17.25	19	23	27	34.75	34
Stroke, inches	S	$2\times D$	28	28.5	30.5	34.5	38	46	54	69.5	35
Diameter of piston-rod, inches to nearest sixteenth-inch.	p	$.018\times D\times\sqrt{P}$	2.5	2.5625	2.75	3.125	3.4375	4.125	4.875	6.25	36
Cross-section of cylinder, square inches, revised value.	(A)	$.7854\times D^2$	153.9	159.5	182.7	233 7	283.5	415.5	572.6	948.4	37
Cross section of piston-rod, square inches.	o	$.7854\times p^2$	4.9	5.2	5.9	7.7	9.3	13.4	18.7	30.7	37½
Effective cross-section of cylinder, square inches, revised value.	(q)	$\frac{2\times(A)-o}{2}$	151 5	156.9	179.8	224.9	278.9	408.8	563.3	933.1	38
Probable effective horse-power	(E)	$\frac{e\times(q)\times V}{33{,}000}$	150.6	151.5	148.8	147.5	150.6	148.8	149.8	150.1	39
Clearance in equivalent length of cylinder, inches, revised value.	(c)	$\frac{c}{100}\times S$	.98	1.	1.07	1.21	1.24	1.38	1.35	1.74	40
Volume of clearance space at each end, cubic feet.	N	$\frac{(c)\times(q}{1728}$	.0859	.0906	.111	.157	.199	.326	.440	.938	41
Volume of cylinder and clearance at one end up to .95 stroke, cubic feet.	v	$\frac{.95\times(q)\times S}{1728}+N$	2 418	2.549	3.126	4.423	6.026	10.665	17.163	36.591	42
Number of strokes per hour	w	$\frac{V\times 12\times 60}{S}$	11571	11368	10623	9391	8526	7043	6000	4662	43
Absolute pressure at .95 stroke, pounds per square inch	B	$\frac{1/r+c/100}{.95+c/100}\times C$	91 ass'm'd	83	51.6	36 1	28.1	19 7	15.2	11	44
Weight in pounds of a cubic foot of steam at pressure B.	W	From tables.	.2107	1932	.1223	.08830	.06978	.04998	.04109	.02891	45
Weight in pounds of a cubic foot of steam at pressure L.	w	From tables.	.04472	.05805	.08323	.1181	.1513	.2118	.2303	.2303	46
Pounds of steam used hourly, calculated by piston displacement.	Q	$w\times(v\times W-N\times w)$	5851	5539	3963	3494	3328	3268	3627	3925	47
Mean total pressure during expansion, pounds per square inch.	U	$C\times\frac{hyp\ log\ R}{R-1}$	.....	80.3	67.1	55.1	47.6	38.3	32.2	26.3	48
Ratio of mechanical effect during expansion to total mechanical effect.	I	$\frac{U\times(r-1)}{r\times(n+b)}$	.....	2'8	.411	.534	.591	.666	.699	.749	49
Units of heat required hourly for the work of expansion	i	$\frac{(n+b)\times I\times(q)\times S/12\times w}{772}$	.....	110052	189649	274063	348205	456091	554981	687080	50
Latent heat per pound of steam at pressure B, british thermal units.	(l)	From tables	.....	893	916	931	942	955	965	976	51
Pounds of steam condensed hourly for work of expansion.	(C)	$\frac{i}{(l)}$	....	124	207	294	370	477	575	704	52
Thickness of piston, inches, to nearest half inch.	(T)	$\sqrt{D}$	3.5	4	4	4	4.5	5	5	6	53
Internal condensing surface, square feet.	(a)	$\frac{7\times(A)}{144}+3.1416\times\frac{D}{12}\times\frac{S+(T)+2\times(P)}{12}+3.1416\times\frac{p}{12}\times\frac{S+(P)}{12}$	18.9	19.7	22.4	28.4	34.5	50.3	68.7	113.3	54
Probable condensation hourly, on internal surfaces, pounds.	d	$15\times(a)$	284	296	336	426	518	755	1032	1700	55
Probable consumption of steam hourly, pounds. Total.	(w)	$Q+(C)+(d)$	6135	5959	4506	4214	4216	4500	5234	6329	56
Probable consumption of steam hourly, pounds. Per effective horse-power.	(W)	$\frac{(w)}{(E)}$	40.7	39.3	30.3	28.6	28	30.2	34.9	42.2	57

TESTS OF NON-CONDENSING ENGINES WITH UNJACKETED CYLINDERS AND SATURATED STEAM.

Number of Experiment.	Diameter of Cylinder, Inches.	Stroke, Inches.	Clearance, Per cent. of Piston Displacement.	Absolute Imtlal Pressure, Pounds per Square Inch.	Apparent Cut-off, Fractions of stroke.	Piston Speed, Feet per Minute.	Effective Horse-Power.	Steam Hourly per Effective Horse-Power, Pounds.
1				111	0.13	447	125.3	33.4
2				88.4	0.155	450	103.2	32.4
3	22	43.5	3.7	114.4	0.17	445	159.7	30.5
4				91.6	0.18	442	118.3	30.7
5				116.7	0.2	461	194	28.9
6	16.1	48	2.9	79	0.207	481	64.5	33.9
7	16.1	42	3.1	85.6	0.226	564	76.6	29.7
8				89.6	0.245	435	159.1	27.5
9				65.3	0.245	445	94.5	31.2
10	22	43.5	3.7	92.2	0.32	439	190.4	26.6
11				65.9	0.37	413	131.5	30.4
12				48.4	1.	443	137.1	49.8

to the assumed dimensions. Possibly some of those who read this article will furnish other comparative examples, where the conditions agree more closely with the assumed data. If the theory by which the results in line 57 were obtained is correct, it will be useful to designers; and if it is incorrect no one will be more pleased than the writer to see it refuted.

The table of theoretical results contains many interesting and important items, in addition to the final results; items indicating means whereby the steam consumption, as calculated in line 57, can be materially reduced. The table will be discussed in the succeeding article.

Making so-called "wrought-iron" anvils in Germany, and branding them "Trenton," after the New Jersey town of that name, is no doubt an enterprising procedure; but the Eagle Anvil Works, of Trenton, find the joke has a serious side, as a good many of the German anvils get broken, and are sent to them by users to be repaired, under the mistaken impression that they were made by them. Each of theirs bears an eagle as a distinguishing brand.

Improvements in Rope Hoisting Machinery.

The accompanying illustrations show the improvements made in the rope hoisting machines made by the Energy Manufacturing Company, Philadelphia, Pa.

Fig. 1 is the style of machines made to lift 1,000 and 2,000 pounds. The hoist to lift 500 pounds is the same in general appearance, with the exception of having only a single load rope, doing away with the movable block. Fig. 2 shows the manner in which the load rope is kept from slipping. Referring to the cut *E* is a lug (part of the frame) on which the yoke *H* is pivoted; *L* is a stud (one on each side of the yoke) fastened into the frame; *A* and *B* are rollers which have their bearings on the yoke *D* at the bottom of the frame, and also guide for the load rope; *J* is a small weight fastened to the end of the rope so that it cannot be pulled off; it is to keep the rope from kinking and untwisting. If a load is put on the hook *K* the rope will push the yoke in the direction of the arrow *P*, causing the roller *A* to bind the rope slightly into the wheel *I*. The jamb nuts *C* prevent the yoke from pushing any further than is required to bind the rope when no load is on. The rope is not bound, which allows the machine to work easily.

Among the improvements recently made has been the enlarging of the ropes. The hand ropes are made endless by joining together with couplings, which prevents the rope kinking should it get wet. The brakes are now made to hold a load at any point when raising or lowering. The speed of lowering is regulated by the pull on brake cord.

Fig. 3 shows the manner in which the brakes are constructed; 3 is a lever placed on the eccentric 5, and 4 is a shoe attached to the lever. No. 2 is a ring secured to the hand rope wheel *I*. It will be seen if the hand rope wheel is pulled in the direction of the arrow *U*, that the brake will rise and allow the load to be hoisted; but as soon as the hand rope is let go, the wheel will run in the direction of the arrow *D*, and the brake will expand in the rim 2, preventing the lowering of the load. The brake 6 used in lowering is connected by the rod *O* to the eccentric brake; 9 is brake lever, and 8 the shoe. If the brake cord 12 is pulled upon, it releases the eccentric brake and at the same time brings the shoe 8 against the outside of the ring; by regulating the pull on the brake cord, the load is lowered at any speed.

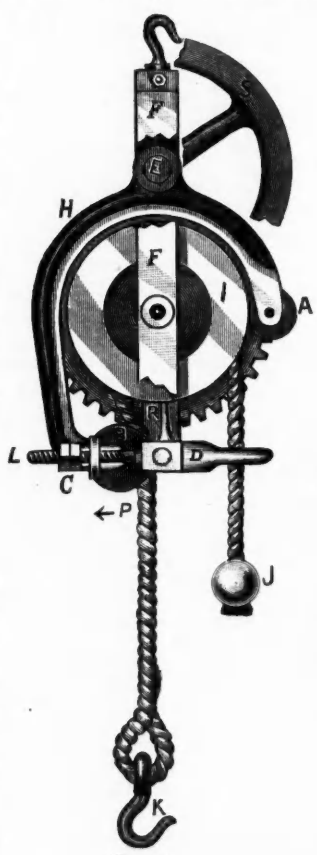


FIG. 2.

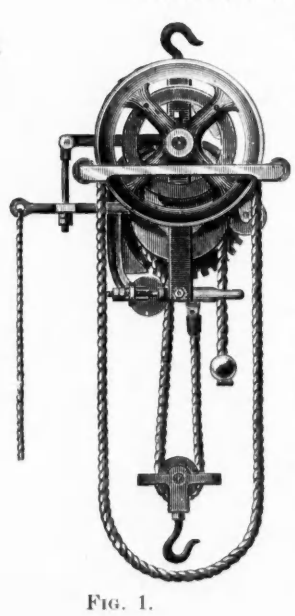


FIG. 1.

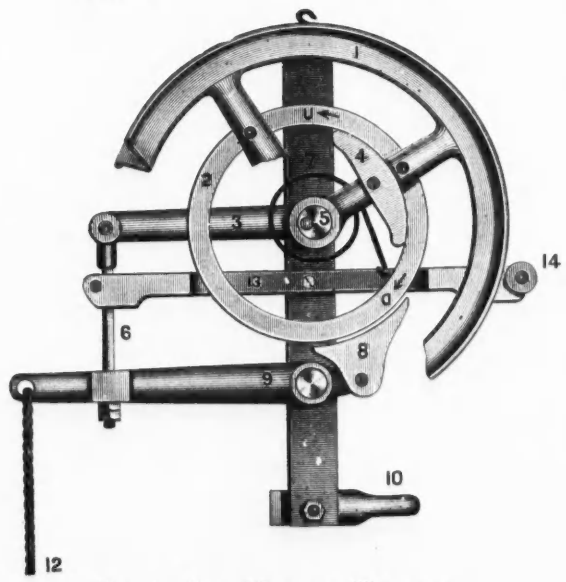


FIG. 3.—ROPE HOISTING MACHINERY.

Among the advantages claimed are that, in lowering the load, the operator has only to pull the brake cord, having one hand free to guide the load to the proper position.

The load rope when worn out can be replaced at a small cost, and there is comparatively nothing to wear out. The hook can be pulled up or down by hand instead of the slow process of pulling on hand rope. The hoist can be used for long or short lifts.

LETTERS FROM PRACTICAL MEN.

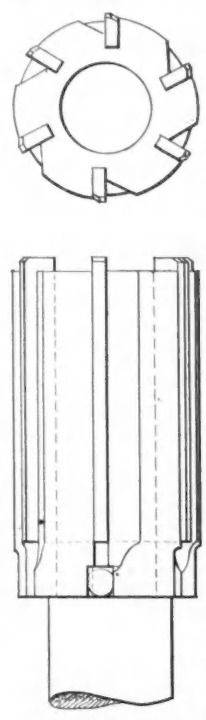
About Reamers.

Editor American Machinist:

The article in the June 2d issue of your paper on the subject of "Reamers," by Mr. Richards, has certainly introduced a subject we have not a very extended knowledge of but one thing I think we are all agreed on is, that it is a practical impossibility to maintain sizes of holes within a small fraction, in ordinary cast-iron, with a solid or unadjustable reamer; at least we have found it so. I have, in consequence, been forced to try and find some way to keep our sizes more nearly uniform than we were able to with solid reamers, and the only perfectly satisfactory way I have so far found for producing a 1" hole 1¼" deep in a light piece of cast-iron is to bore and ream the hole about .002" under size, then place on mandrel and finish outside, roughing off the ends; then to grind the hole with a small emery wheel in our Brown & Sharpe Universal Grinder to a solid gauge, and then to square off the ends to length in the lathe; this is our most exacting job, however.

We have a number of pieces requiring a 1⅛" hole about 3" deep, going through the piece, and after a very limited use of our solid reamer we were unable to use it longer, because of its excessive wear. To get the last of the holes to the size of the first ones near enough for this work we resorted to the expedient of shimming up with a stick and pieces of tissue paper, and so managed to get out some 25 or 30 pieces. This is a very short life for a solid reamer, but we did not allow .001" variation in size. We then purchased some adjustable reamers covering the sizes most used, viz.: 1⅛"—1" —¾", but we were unable to do anything with them; the holes they made would vary two or three thousandths, the amount of variation depending on the amount of stock to be removed; and because of the spring of their cutters, you must of necessity take a heavy cut, or none. In the meantime our smaller sizes had been wearing so that we could not get our work together, and I got out of all further patience with the solid reamers. And so we made some spring reamers for sizes under ¾"; they are the same in general design as used in some sewing machine work, and for our use (that is, keeping sizes to gauge) they so far give good satisfaction. For our 1⅛" holes we now have a reamer made on the plan of one shown me at the works of Brown & Sharpe, which is to all intents and purposes a solid reamer, with an adjustment for wear, and seems to us the best of anything we have found for its particular use. As I have not their permission to describe it, I cannot.

For holes of 2", 2¼" and 2½" I, the other day, made some cast-iron shell reamers with inserted cutters, which work very well, and are practically solid reamers, with the means of retaining size and edge. The 2" size is shown in sketch herewith, and may be described thus: The body of cast-iron is 3½" long, and bored with a 1" hole for the shank (which fits all three sizes); it is in diameter ⅛" smaller than the size of hole it is intended to make. It is then grooved with a ⅛" slotting saw for six cutters, the grooves being so placed as to bring the cutting faces of the cutters radial. These grooves are milled on a taper of ⅛" to the foot, the deepest at the entering end of reamer. The cutters are of ⅛"×½" bar steel, worked off on the emery wheel to a thickness that will go in the grooves, then cut to lengths, planed to taper required, and hardened as hard as we could make them; if they spring in hardening only a little, no matter. We then lapped the inner edges up straight, and after liberally easing the sharp corners left by lapping, drove the cutters solidly into place, leaving the entering ends projecting as shown. Then mounting the complete shell reamer on our milling cutter grinder, we ground it to size, as you would any long mill. When it gets dull or loses size, by forcing each cutter slightly further in and regrinding, you have a new reamer again.


ABOUT REAMERS.

The holes this tool makes do not look like a gun barrel, but they are as good as are commonly made. In grinding one of these reamers you may have the unexpected happen, and very unexpectedly, too. All at once the wheel will apparently jump into the cutter, and the temper is drawn, both in the cutter and yourself; the cutter will be found to have pulled out of the shell. When you get the cutter out to reharden, the nice, straight lapped back will be found quite rounding. I resolved to straighten it when rehardening, got it heated, looked for bend, it was all straight again of itself. Just why these bends stay and leave as they do, or, in fact, why they come as they do, I cannot as yet satisfactorily explain; but this is our experience. CHAS. S. BEACH.

The Term Case-Hardening.

Editor American Machinist:

At the commencement of the article on case-hardening in your last issue, by Mr. B. F. Spalding, an article in which I was very much interested, I noticed that Mr. Spalding speaks as if the term case-hardening was derived from the fact that such hardening is usually done in a *case* or box.

Now I always supposed, and I think it is the general impression among mechanics, that the term was derived from the fact that the article which has been put through the process, consists of an interior composed of iron which is soft, or nearly in its original condition, enclosed in a skin or *case* of hardened metal. It is easy to see that the term could have been derived from either circumstance, but I think it would interest your readers to know which one it did originate from.

Perhaps Mr. Spalding or some others of your readers may be able to inform us when the term was first used and by whom, and what suggested it. FAY.

Hobbing Worm Gears.

Editor American Machinist:

The device for hobbing the teeth of worm gears, without previously "nicking" the blank, described by Geo. H. Frizzell, in your issue of June 9th, is not novel, and is not open to public use. It was invented by Chas. Albro about 1880, and his patents are now owned, I believe, by Morse, Williams & Co., of Philadelphia.

There are also several U. S. patents on special arrangements of the same idea, owned by the Pratt & Whitney Co.

Geo. B. Grant.

[Mr. Frizzell did not claim, in his article referred to above, that the idea of driving a worm wheel at the proper speed, by means independent of the hob, was new, but said that, so far as he knew, it had never been "applied to the universal milling machine."

We were aware that others were driving worm wheels while hobbing them, but by different means. In our issue of April 28, under the heading of "Shop Notes," we mentioned Pratt & Whitney's method of doing it. The simple fact that there are several patents on the subject would seem to indicate that no one can be prevented from driving worm wheels by means independent of the hob, provided a new way of doing it is devised, and, so far as we know, the method described by Mr. Frizzell is new.]

Practical Drawing.

By J. G. A. Meyer.

FIFTY-THIRD PAPER.

467. The full lines in Figs. 350, 351, 352 (52d paper) are the projections or represent three different views of a solid whose form is similar to that of the butt end of a connecting rod. Now let us pause for a moment and consider the relative positions of some of the prominent points in Figs. 350 and 352. In order to make our remarks clear and comprehensive we shall here recapitulate some of the principles given in former articles. The line $A\ B$ is the ground line, and according to Art. 220 is the line in which the vertical plane meets the horizontal plane of projection. In projecting a solid on the vertical plane, this plane is assumed to stand perpendicular to the horizontal plane or surface of the paper (see Art. 218), and when the vertical projection of the solid has been made, the vertical plane is supposed to be revolved around the line $A\ B$ until it coincides with the plane of the paper, so as to bring the projection in full view on the paper. Consequently, the ground line $A\ C$ represents the edge of the vertical plane of projection when it stands perpendicular to the plane of the paper, and after the vertical plane has been swung over, so as to coincide with the plane of the paper, the ground line $A\ B$ represents the line of intersection, or, in other words, the line in which the vertical and the horizontal plane meet each other. From these remarks it must be obvious that in Fig. 350 the flat surface, which is directly exposed to view, is that one which is bounded by the straight lines $o\ o_3$, $o_3\ p_3$, $p_3\ p$, and the curve $o\ a_5\ p$, and also represented in Fig. 351 by the straight line $o_2\ p_2$; that is to say, in the former figure we see the whole outline of this flat surface, and in the latter figure we see the edge of the same surface. This surface is, of course, parallel to the plane of the paper. The line $o_2\ o_4$ in Fig. 351, and the line $o_3\ m$ in Fig. 350, represents another one and the same flat surface standing perpendicular to the plane of the paper. Part of the line $m\ o_3$ (Fig. 350) namely, $o\ o_3$ represents the edge in which the surface $o_3\ o\ a_5\ p\ p_3$ meets the surface $m\ o_3$, and the remaining part $o\ m$ of the line $o_3\ m$ represents the intersection of the surface $o_3\ m$ and the surface of revolution. The line $p\ p_4$ in Fig. 351 and the line $p_3\ n$, Fig. 350, represent another surface standing perpendicular to the plane of the paper, consequently the line $p_3\ p$ in Fig. 350 represents the edge in which this surface meets the surface $o_3\ o\ a_5\ p\ p_3$ and the line $p\ n$ represents the intersection of the surface $p_3\ n$ and the surface of revolution. The line $o_4\ p_4$, in Fig. 351, drawn parallel to the ground line $A\ B$, represents a flat surface whose outline in Fig. 350 exactly corresponds and coincides with the outline of the surface $o_3\ o\ a_5\ p\ p_3$, or we may say, the surface represented in Fig. 351 by the line $o_4\ p_4$ is, in Fig. 352, hidden by the surface $o_3\ o\ a_5\ p\ p_3$.

468. Now let us turn our attention to Fig. 352. The full lines in this figure represent a vertical projection or side view made on, what we have called in Art. 400, the second vertical plane of projection. This plane of projection is assumed to stand perpendicular to both the horizontal and vertical plane of projection, during the time the projection of the solid is made upon it. When in this position we can only see its edge, which is represented by the line $C\ D$. After the projection has been made upon this plane, it is revolved around the line of which C is the horizontal projection until the line $C\ D$ coincides with $A\ B$. In revolving the plane in this manner about the axis C, every point in this plane will describe arcs such as u_2, u_3, u_4, described from the center C. This second vertical plane of projection is then revolved about the line $C\ B$ until it coincides with the plane of the paper, thus bringing the outline of the solid in full view. (See Art. 400.) Now, it must be evident from the manner in which the projection shown in Fig. 352 has been obtained, that the line $o_2\ o_4$ in Fig. 351, and the flat surface in Fig. 352, bounded by the straight lines $o_7\ o_9$, $o_9\ o_{11}$, $o_{11}\ o_5$, and the curve $o_7\ u_7\ o_5$ represent one and the same surface; and is that surface which is directly exposed to view. Behind this surface is another one whose boundary lines are precisely the same as, and coincide with the boundary lines of the flat surface exposed to view. This surface, which cannot be seen in Fig. 352, is represented in Fig. 351 by the line $p_2\ p_4$. Furthermore, the line $o_{11}\ a_{17}$ in Fig. 352, and the line $o_2\ p_2$ in Fig. 351, represent another flat surface, which is standing perpendicular to the vertical plane of projection or the surface of the paper; and lastly, the line $a_{15}\ o_9$ in Fig. 352 and the line $o_4\ p_4$ in Fig. 351 represent a flat surface which is parallel to the surface represented by the line $a_{17}\ o_{11}$ in Fig. 352.

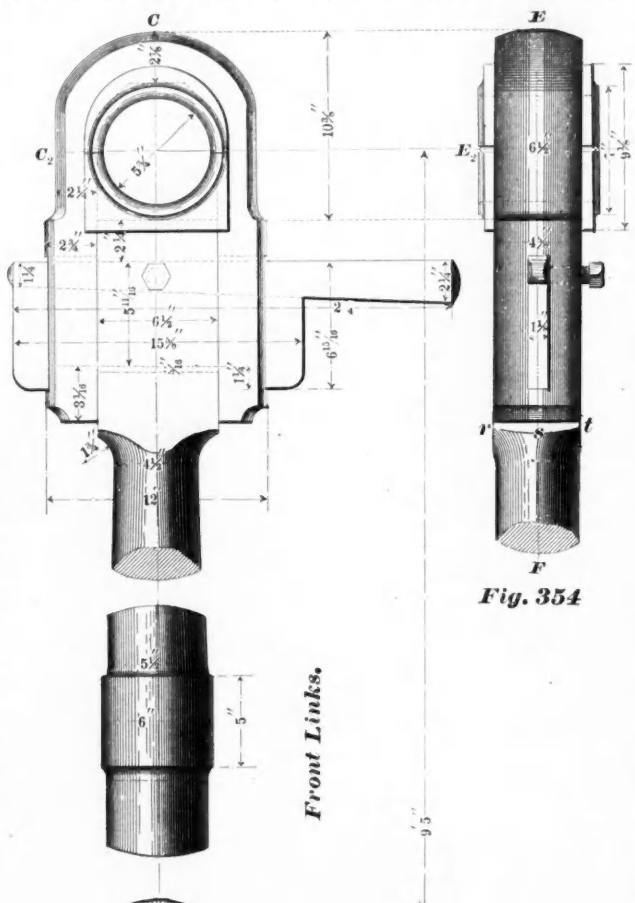


Fig. 354

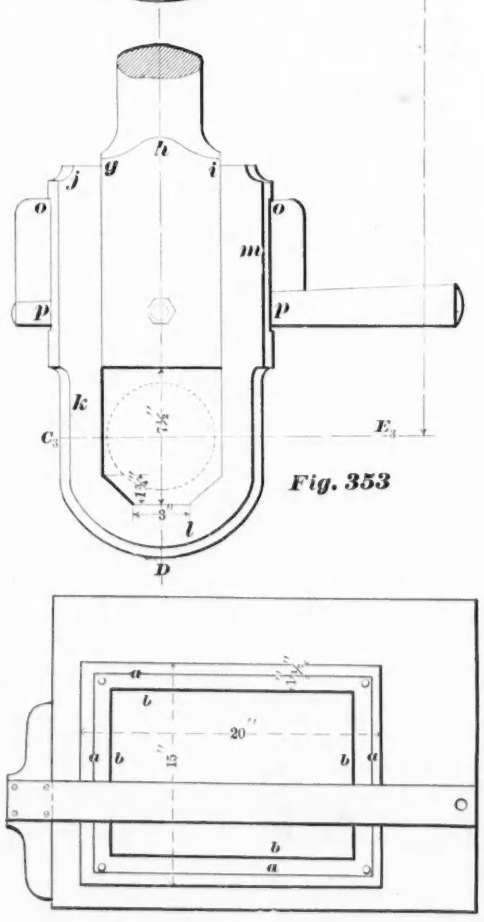


Fig. 353

Fig. 355.

469. From these remarks made in Art. 467, and also, in Art. 468, it must be evident that the line $m\ o_3$ in Fig. 350, the line $o_2\ o_4$ in Fig. 351, and the plane bounded by the lines $o_7\ o_9\ o_{11}\ o_5\ n_7$ in Fig. 352 all represent one and the same surface. Again the line $n\ p_3$ in Fig. 350, $p_2\ p_4$ in Fig. 351, and the surface hidden in Fig. 352 by the plane $o_7\ o_9\ o_{11}\ o_5\ n_7$, all represent another one and the same surface, which is parallel to the surface whose boundary lines are fully exposed to view in Fig. 352. Hence it follows that the points m, n in Fig. 350, and the point n_7 in Fig. 352, must lie in one and the same horizontal line, otherwise the drawing is not correct. The points o p in Fig. 350, and the points o_7, o_5 in Fig. 352, must also lie in one horizontal line, because they represent the extremities of the edges of the rectangular part of the solid, and these edges are all of equal lengths, because, in the first place, they are at equal distances from the axis of the surface of revolution, and secondly, the lengths of these edges are limited by this surface of revolution, and also by the base ff_3, which is perpendicular to the axis $x_3\ y_3$, and is also parallel to the ground line $A\ B$; consequently the extremities of these edges must be at equal distances above the ground line $A\ B$. In a similar manner it can be shown that the point a_5 in Fig. 350, and the points a_{15}, a_{17} in Fig. 352, must lie in the one and the same horizontal line.

470. It may be well to remark that, for instance, in passing the cutting planes represented by the lines $m\ o_3$, and $n\ p_3$ in Fig. 350, through the solid, we cut off a portion of the curve $g\ a_5\ k$; and therefore the student should be careful not to confound the points g and k with the points o and p; when the portions separated by the cutting planes are removed the points g and k are also removed. Similar remarks apply to the points e_7, e_{11} in Fig. 352.

Directions.—In the space marked Prob. 68 draw three views of a solid, as shown in Figs. 350, 351, 352. The dimensions of the solid to be drawn are to be the same as those of the solid shown in our illustrations. Remember that the dimensions omitted in these figures will be found in Fig. 348. Find the curves of intersection as explained in this problem. Use a 3-inch scale.

471. As we advance in these lessons we shall from time to time apply to practice, that is to say, to the manner of making correct working drawings, the knowledge gained in the problems which are to follow. Although we do not intend to restrict ourselves, in making these practical applications, to any particular branch of practical drawing, but select such cases to which the application of the principles set forth in our problems can be made with the greatest advantage and profit to the student, we shall in many cases, when drawings of machinery are to be made, select details of a marine beam engine, whose cylinder is 56 inches in diameter, and the stroke equal to 12 feet. Now, since we are to commence to make regular working drawings whenever our progress in this study will permit, it will be best to follow the practice of first-class drawing rooms, and establish the size of the sheet of paper on which these working drawings are to be made. For this purpose we recommend a sheet 20×15 inches, which is the size of Whatman's paper called "Demy." (See Article 71.) But it must be understood that, for the construction of problems, we retain the former size of drawing paper, namely, 25×20 inches. The sheet whose dimensions are $20'' \times 15''$ we shall hereafter call "the small sheet," and the other (25×20) "the large sheet."

472. When the drawing paper is smaller than the drawing board, as will be the case when we use the small sheet, it is customary to fasten the sheet near the bottom edge and the left hand edge of the drawing board, as is shown in Fig. 355. This custom we should follow, as it will lighten the labor of making a drawing.

Although in many drawing offices borders are not drawn around a working drawing, for the reason that time will not permit, and that a border does not add anything to the value of a correct drawing, we recommend, for the sake of appearance and practice, that all our working drawings shall have a neat single line border. Hence, after the small sheet has been fastened to the board as directed, first draw, as shown in Fig. 355, a set of border lines $a\ a$ at a distance of one-half inch from the edges of the paper. Inside of these border lines, and a distance of $1\frac{1}{2}$ inch from the edges of the paper, draw another set of border lines $b\ b$; this last set is to be inked when the drawing is finished, and the sheet is to be trimmed off to lines $a\ a$, making the size of the sheet equal to 19×14 inches when the drawing is taken off the board.

Problem 68*A*.

473. Practical application of a number of the foregoing problems.

It is required to make a correct and complete working drawing of one of the front links as shown in Figs. 453, 454. This link has been designed for a marine beam engine whose cylinder is 56 inches in diameter, and stroke 12 feet.

The student should be very particular to work out correctly all the intersection of surfaces. For instance, the curves $g\ h\ i$ and $r\ s\ t$ must be found by the method given in our last problem; the intersection $j\ k\ l\ m$ is found by the method given in Problem 65, and illustrated in Figs. 339 and 340; and the amount that the lines $o\ p$ recede from the outline of the strap is found by the method given in Problem 58 and shown in Figs. 298 and 299.

In commencing a drawing of any object whose outline is symmetrical, as in the case before us, it is always best to first draw the center lines $C\ D$, $E\ F$, $C_2\ E_2$, $C_3\ E_3$, and then work around these lines. Even when a set screw or a bolt is to be drawn, always draw its center line first.

474. The rod itself is shown to be broken; this is often done to save room, and thus enable the draftsman to make the drawing to as large a scale as possible on the established size of the drawing paper in an office. This method of showing a piece of mechanism broken, is only permissible in cases in which no doubt exists as to form of the part which

is not shown. Thus, for instance, in the case before us it is understood that the taper of the rod is straight; but if the contour of this part of the rod has to be a curve, then the whole length of the rod must be shown, to enable us to indicate the kind of curve required, as will be explained hereafter.

Directions.—Make this drawing on a small sheet. Use as large a scale as possible, so as to keep the outline of the link inside of the border lines.

Locomotives for Towing on Canals.

From the remarks made by many of the speakers at the recent Conference on Canals at the Society of Arts, it might be supposed that railways and canals are irreconcilable antagonists. Last week, however, an experiment was made on the Shropshire Union Canal at Worleston, by officials of the London and North-Western Railway, which is suggestive of the lion lying down with the lamb. A set of rails of 18" gauge was laid down on the canal bank for a distance of about a mile, and a small locomotive from the Crewe railway works was placed on the line. When steam was up two boats were attached by ropes to the locomotive, which drew them along easily at the rate of seven miles an hour. Four boats were then attached, and the same speed was attained. The locomotive worked very smoothly, and the experiment is looked upon as a success.—*Industries.*

The *American Artisan* says:

There are many people who think it is an easy thing to solder a hole in an old tin pan; but, like many other tricks of the trade, can only be acquired by practice. The great trouble with most persons when they try to solder anything is, that they do not get the work clean—that is, scraped bright; then the tin may be all scraped off, and if they try to solder with rosin, the solder does not stick. When acid is used, there may be so much on the article that the acid does no good. Then the soldering copper is apt to be either too cold or too hot, and the result will be that a poor job is done.

Common Sense Piping.

BY WM. J. WILLIAMS.

Of all things connected with mechanics, there is hardly any branch more capable of being bungled than the putting together either a few pieces of pipe for what would seem to be a very simple object, or enough to pipe an entire building. If enough experience has been attained to cut a piece of pipe and put a thread on it, an ability is often assumed capable of handling the most particular kind of a job.

The accompanying sketch shows the portion of the piping of a pump used as a boiler feeder, and also to supply a tank with water. The tank was under the roof of a four-story building, and was to be supplied with either hot or cold water. Originally the system did not have the part containing the valve *B*, 45° elbow, and the Y of which they are a part. Previous to this addition the pump fed the boiler and supplied the tank with water alternately. Assuming the pump to be at work feeding the boiler, and wishing to change off to the tank, the operation would be:

1st. Stop the pump; 2d. Close the stop valve (not shown) at the boiler; 3d. Close valve *A;* 4th. Open cock *D;* 5th. Open valve *C;* 6th. Start pump. This would give cold water to the tank.

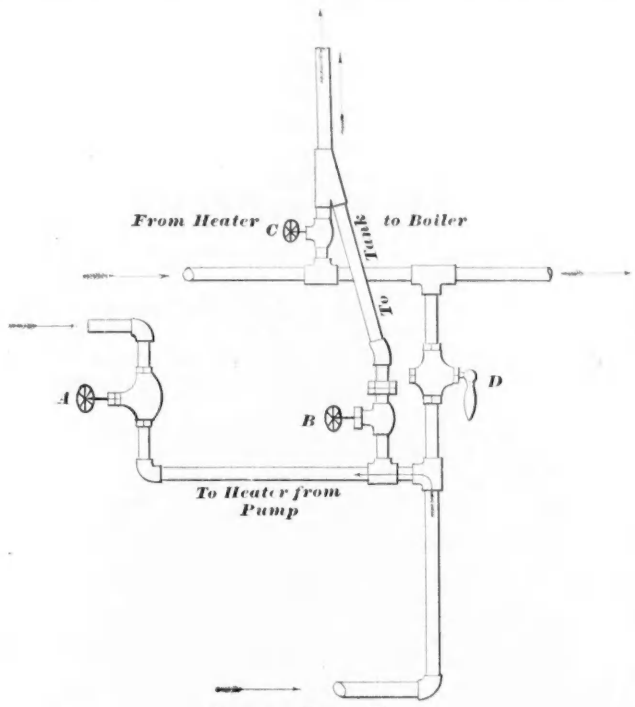
To change to hot water:

1st. Stop the pump; 2d. Close cock *D;* 3d. Open valve *A;* 4th. Close valve at boiler; 5th. Open valve *C;* 6th. Start the pump.

To make the addition to get rid of all the above complication, less than four feet of pipe was required, and five fittings, viz.: one tee; one globe valve; one union; one 45° elbow and a Y, or lateral branch, as it is sometimes called. The operation of pumping then became:

1st. Open valve at boiler; 2d. Open valve *A;* 3d. Open supply valve at pump (not shown); 4th. Start the pump.

If cold water is needed in the tank, open valve *B* just enough to allow the surplus of pump's capacity over that required for the boiler to pass up into the tank. If hot water is needed, keep valve *B* closed, and open valve



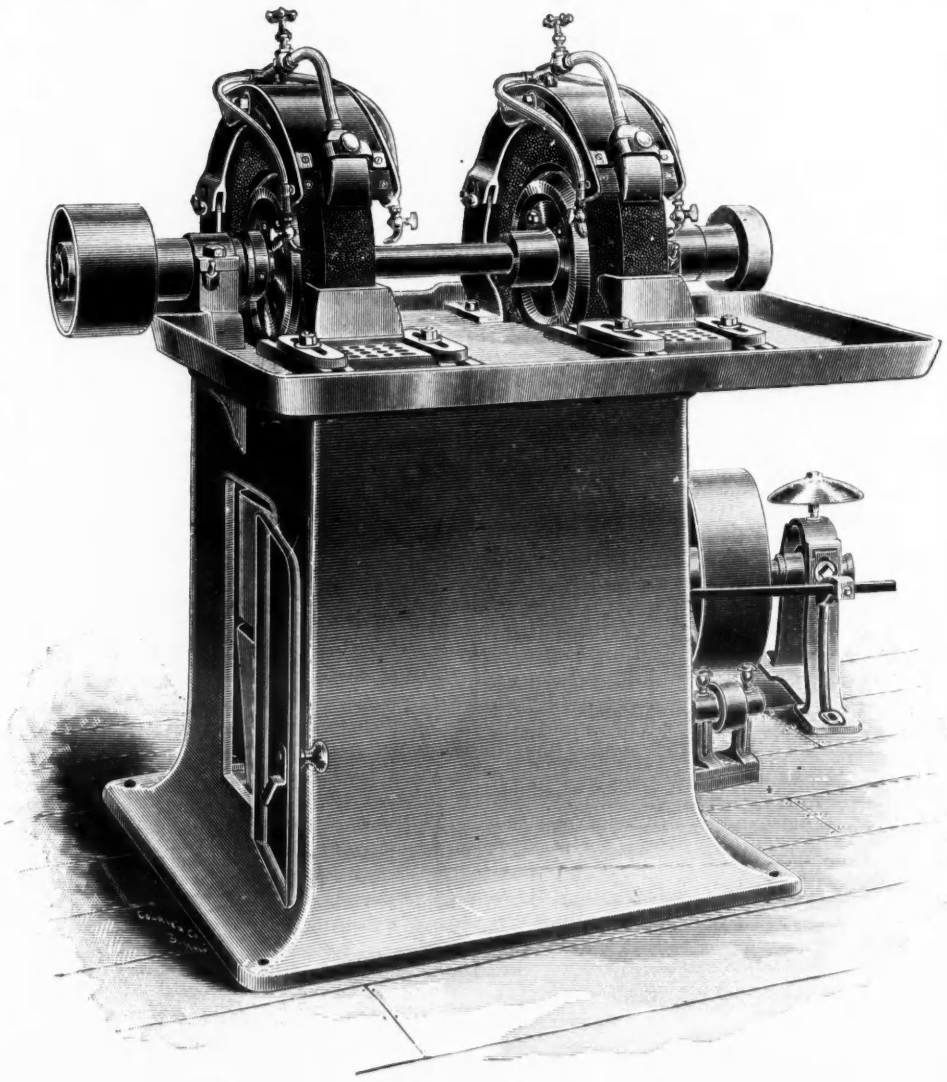
COMMON SENSE PIPING.

C a sufficient quantity to take away the surplus of pump. Cock *D* was rendered useless.

By the change, the boiler feed, instead of being at intervals, became continuous; also the tank. By the old arrangement every chance existed to get a wrong valve closed somewhere, when disaster was very likely to follow. By the new arrangement no such chance existed. The pump, once started, continued to work as long as the engine was running, and by manipulating either of the valves, *B* or *C*, which became the regulating valves for the proper quantity of feed water for the boiler, the capacity of the pump could be thrown either to the tank or the boiler.

It took perhaps two dollars' worth of material to make the change, but more than ten dollars' worth of argument for it, and six months' time, before a half-hearted consent was given to try it. While the change was being effected sundry visits were made, and admonitions to be careful were plenty. An idea seemed to be prominent as to the possibility of success; if the thing did work it would possibly be at the expense of the pump breaking down. For six days after the new arrangement was made it was daily visited, and such questions as the following were asked:

Well, how is it? Is it working yet? Is it all right? etc., etc. The idea was that, because the pump discharged its water at two different points, the resistance was equal to the boiler pressure (70 lbs.) plus pressure due to column of water to tank (30 lbs). It was endeavored to show that the work on the pump was not increased to any appreciable extent, and in support of that theory the question was asked: Suppose the pump had to supply feed water to two boilers, each carrying 70 lbs. pressure, and we were to feed both boilers at the same time; would the pump be working against 140 lbs. pressure? Well, no, they did not think it would; but still the tank problem would not solve itself satisfactorily. However, at last date of information the pump was still doing its double duty, and every one was satisfied. To those conversant with the subject it may seem strange to doubt so simple a proposition, but the writer has met with many such cases in his time, and the provocation has been great, occasionally, to lose the center of gravity of forbearance.



EMERY TOOL GRINDER.

Improved Emery Tool Grinder.

The accompanying engraving represents a machine made by the Springfield Glue and Emery Wheel Co., of Springfield, Mass. As shown by the cut, it is a heavy machine, weighing about 1,800 lbs., and the form of base is such that it is very rigid; when placed on a good foundation it is free from tremble and vibration. It has a two-inch steel spindle and two emery wheels, each 20×3 inches, with 10-inch hole in them, and held by large collars. By means of the large holes there is no hub or center of wheel to throw away, and future wheels for the machine cost less from having these large holes.

The machine is generally furnished with emery wheels of two different grades, one coarse, for rapidly removing the stock, and the other fine, for finishing to a good edge.

An iron tank, easily reached, is placed under the wheel to receive the water coming from it, and catch the waste ground off, which settles to the bottom. When sufficient collects, the tank can be quickly drawn out and emptied. The water overflows from this tank, comparatively clean, into a second tank directly underneath, to which a centrifugal pump is attached, and fixed to carry the water to the wheels, where valves regulate the flow to the desired amount.

Having the pump connected to only the lower tank leaves the upper tank free from pipe connections, so it can be quickly emptied. Water flows on the wheel through a small opening on the underside of the water distributor, which spreads it in a sheet across the face of wheel.

The machine stands 38 inches high from floor to center of spindle; the wheels are 16 inches apart; floor space, 33×34 inches.

The University of Cambridge, England, occasionally confers the degree of doctor of laws upon men who, from the experience of age, and great learning, have earned the title. Recently this degree was conferred upon six individuals, and the first name on the list was that of Prince Albert Victor of Wales, twenty-four years of age, who is not popularly supposed to know a great deal about anything in particular. The others who received the—under the circumstances—doubtful compliment, were very probably entitled to it. When institutions of learning prostitute themselves to such ends as this in favor of a sprig of nobility, what wonder that people lose all faith in their dictum? It might be possible to think of something as silly as this, but we are unable to do so just at this time.

It may be set down as a fact that a good deal of foreign trade is lost to this country through lack of effort to secure it. The same effort put forth by manufacturers and merchants to secure trade with Central and South American States, that is expended in getting home trade, would often yield better results. Trade with these States could be easily doubled or quadrupled. Right at home, and in competition one with the other, our merchants and manufacturers are not lacking in efforts to sell. In many—perhaps the most—lines of trade the cost of selling makes a large—sometimes enormous—increase in price necessary. There is often too much energy for the good of anybody expended in the efforts to make sales at home. There is opportunity to learn a good deal from European countries in this respect. Representatives from European manufacturers and merchants are always to be found wherever there is a prospect of selling their goods, and they get the trade, as a matter of course. Modern methods of selling call, in almost every instance, for a good deal of personal solicitation; without this, goods are not likely to be sold, to any great extent.

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Courtesy.

A great deal is said in the papers, in books, in the pulpit, and in the schools, regarding the duty and advantage of a courteous treatment of those with whom we come in contact in our business and other relations of life, and it is not our purpose to add anything to what has been said on that subject in a general way, but no one who has been much thrown into contact with men of the world can have failed to notice some of them, who show that in the abstract they appreciate the advantage in a business and social way, which is to be secured by a gentle, suave and pleasant manner, yet who continually show that they fail to recognize the important truth, that it pays to treat *every one*, no matter how humble their station, with respect and courtesy; and that whether it pays in a financial sense or not, it pays in a much higher sense, and is a duty we owe to others, whether it pays at all or not.

How often we see a manufacturer, for instance, who, when a man calls at his office wearing good clothes and a silk hat, treats him with every mark of respect, and with the utmost courtesy, even though he knows that he comes to him with a business proposition which it would ruin him to accept. Then let one of his men, upon whom the success of his business depends, approach him in his shop clothes and apron, and even though he is known to be an honorable and valuable man in every respect, and comes upon a matter of business in which both are interested, and both likely to be benefited, and he is liable to be treated in a manner as offensive as it is unreasonable and ungentlemanly.

And why? Simply because his employer, instead of being a real, genuine gentleman, whose manners have their source in the heart, is a selfish churl, who is polite only to those who he thinks are in a position to make it uncomfortable for him if he fails to treat them respectfully, and whose "courtesy rarely comes, but either for gain or falsehood." Such men deserve, and always secure, the cordial contempt of all honest and fair-minded men, who believe in fair play, and that a "man's a man for a' that."

A man who treats every one with whom he comes in contact in a rough and disagreeable manner, and who is so constituted that he cannot do otherwise, is unfortunate, of course, but he may be, and usually is, honest, and in every way deserving of greater respect from others than he is able to show by his manner that he feels for them; but the one who, by his treatment of the influential and powerful, proves that he is capable of treating people with respect and civility, and then at the same time, by his treatment of those who are without influence or power, and who are perhaps dependent upon him, proves that he dons his smiles and suavity, only when he thinks he sees a direct advantage to himself by doing so, is a coward, and deserves no respect whatever, from anyone; and, moreover, he overlooks the fact that those who to-day may be weak and helpless may to-morrow be influential and powerful, and that, as the saying goes, the "friendship of a dog is more valuable than his enmity," and there are a few men in the world who seem to forget that men, even though they work for a living, are somewhat superior to dogs, and that their friendship is to be valued proportionately higher.

It is no sign of smartness to treat those beneath you in a contemptuous and offensive manner, and the most successful managers of large manufacturing concerns we ever knew were those of whom it was said, among the men, "He treats everybody alike, and if you have any business with him you can walk into his office, and talk with him about it, and you will be treated like a gentleman."

Licensing Engineers.

When the effort is made to bring about the licensing of stationary engineers outside a very few large cities it results in failure. As no license law aims to go beyond establishing the fact that the man licensed has, in a moderate degree, the ability to avoid conditions that endanger the life and property of his neighbors, the argument against it is about as sensible as an argument would be against the law making it an offense to fire one's own property to the endangering of the property of others.

There is a sort of glamour about becoming an engineer, by title, that a good many incompetent men cannot resist, and the low wages for which such men will work, and the risks they will ignorantly take, prove too much for a good many employers.

The saw mill boiler continues to let go with the regularity that might be expected under the circumstances, but its lesson is unheeded. Nothing less than a complete revolution in public sentiment, born of a better knowledge of the subject, will bring about, in this country, anything like a general license law for stationary engineers. In no civilized country in the world are steam boilers operated with so great a disregard for human life as they are in many parts of this country.

P. T. Barnum has been before the American public for a time that exceeds the memory of the average American citizen. He has catered to the amusement of the people, and in doing this he has done a good thing. Nothing is more needed in this country than popular amusement—something that the masses can take advantage of. Mr. Barnum has frequently humbugged amusement seekers, but he has amused them at the same time, and that is exactly what he set out to do. His humbugging has scarcely been concealed, and it has always been innocent in its character. He has accumulated money in his business, for which everybody is glad. And now, when he has reached a ripe old age, he proposes to give a large slice of his fortune for the erection and keeping up a building devoted to science and philosophy at Bridgeport, Conn. The world will be materially better for the fact that P. T. Barnum lived in it. We hope he may live for many years, to note the effect of his benefaction.

It would be a very convenient thing if the amount of deposits in the savings banks gave a comparative idea of the condition of the workingman in this country. Unfortunately it does nothing of the kind. With money to be had at three per cent., and less, the savings banks are doing service for millionaires, as well as for workingmen.

Literary Notes.

TURNING LATHES: A Manual for Technical Schools and Apprentices. A Guide to Turning, Screw Cutting, Metal Spinning, etc., etc. With 194 illustrations. Edited by James Lukin, B. A. E. & F. N. Spon, 35 Murray street, New York.

It is hardly to be expected that a book of this kind will be of material benefit to accomplished workmen, yet we think that hints in the work may be found to be of value. It is certain that no man, whatever his skill, can know all that is to be known on any given subject, and it is just as certain that there are many things connected with turning that the author of his work did not detail in the work, if he understood them. But there are many things explained that will prove of especial advantage to most workmen, and these things will doubtless be worth more than the price of the book. Amateurs and technical students will find this book of great advantage to them, as the aim of the author, whoever he may be, has been to explain, very thoroughly, the processes of the art of turning. The book is cheap at the price, viz., $1.00. Sold by E. & F. N. Spon, 12 Cortlandt street, New York.

NOTES ON THE COMPRESSIVE RESISTANCE of Freestone Brick Piers, Hydraulic Cements, Mortars and Concretes. By Q. A. Gillmore. Ph.D.

In this treatise are given the results of a series of experiments made toward the close of the year 1883. The purpose of these experiments was to obtain additional information to that obtained by previous experiments in regard to the resistance and behavior under compressive strains of hydraulic cement, of mortars and concretes made with cement, of brick piers and of freestone, either in the form of cubes of various sizes, or of prisms square in cross-section, but of less height than corresponding cubes. The tests were made mostly by a machine of extreme delicacy, having a maximum working pressure of 800,000 pounds. It was erected at the Watertown arsenal, near Boston, some years ago, by Mr. Albert H. Emery, under the direction of the Board on Iron and Steel, appointed by the President in accordance with the Act of Congress of March 3, 1875. Many of the results of the experiments are tabulated, the manner of making them described, and convey much and very useful information to engineers and others who have to use these materials. The book is published by John Wiley & Sons, 15 Astor Place, New York. Price not given.

SOME DETAILS OF WATER-WORKS CONSTRUCTION. By William R. Billings, Superintendent of Water-Works at Taunton, Mass. (From 1879 to 1888). With illustrations from sketches by the author.

Questions addressed to the editor of the *Engineering and Building Record and the Sanitary Engineer*, by persons in the employ of new water-works, indicated to him that a short series of practical articles on the details of constructing a water-works plant would be of value, and, at the suggestion of the editor, the preparation was undertaken for the columns of that journal. These notes of actual experience make up the book of the title as given above. It treats on the distributing system, including notes on materials for main pipes, method of lining with cement, tool box, derrick, tools, transportation, field work, pipe plans, trenching and pipe-laying, hydrants, gates, tables of weights and dimensions of cast-iron pipe, and many other interesting notes, containing valuable information.

We believe the author has succeeded in his endeavor to be brief and practical, and has presented the subject in a manner which will be interesting and valuable to those who have had little or no experience in actual construction and desire information and suggestion upon the practical details. The book is published by the *Engineering and Building Record*. New York. Price $2.00.

We have received from the Hartford Steam Boiler Inspection and Insurance Company a bound volume of the *Locomotive* for 1887. It contains nearly 200 pages of reading matter, and in them is treated a great variety of subjects relating to practical matters connected with boilers. The volume sells for $1, and is worth twice the money to any operative engineer or boiler owner.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(307) G. D. D., Charleston, S. C., asks: What kind of glass should be used for a bath in which to heat small articles to be hardened? Will scrap glass do? *A.*—Yes, scrap glass will answer, it should be common lead glass; other kinds, such as the Bohemian, melting at too high a temperature, probably for hardening tools. Cyanide of potassium can be obtained at most any drug store.

(308) I. R., Camden, N. J., writes: A question has arisen here between a couple of mechanics as to whether the screw of a small steamboat has any tendency to roll or cant the boat while in motion in the water, either one side or the other. Please state your opinion. *A.*—The screw will not tend to roll or cant the boat to one side or the other. But the angularity of the connecting rod has a slight tendency to do so.

(309) A. P. R., Harrison, Maine, asks: What is the proper way to fasten propeller wheels to the shaft. The wheel is 40 inches diameter, made of bronze; the shaft is 2 7-16 inches diameter, made of steel. *A.*—Our way would be to turn the end of the shaft, which fits in the wheel, slightly tapered; then secure the wheel by a fore and aft key, and further secure it in position by a key driven through the shaft close to the aft end of the hub of propeller.

(310) J. M. B., Atlanta, Ga., writes: Please inform me if Mr. Meyer in his Modern Locomotive Construction, has ever published how to square up a locomotive engine. *A.*—The meaning of the term "squaring up a locomotive" is indefinite; it sometimes means lining up a locomotive, and at other times, setting the valve gear. Nothing in regard to lining up a locomotive has been published; but the manner of laying out the valve gear and setting of the eccentrics has been explained.

(311) A. S., Dresden, N. Y., asks: 1. What will be the size of boiler required to furnish ample steam to run a small boat 20 feet long, 4 feet beam? Engine has two cylinders 2¾ inch bore 2¼ inch stroke, making 300 revolutions. *A.*—You do not state the depth of boat, neither do you give the steam pressure. But assuming that the mean effective pressure in the cylinder is 60 pounds per square inch, you will need a boiler with 30 square feet of heating surface, and 1½ square foot of grate surface. But whether this engine and boiler will be large enough, we cannot say, because you do not give the draft of water or the load to be carried. For similar reason we cannot advise you as to size of propeller or speed of boat.

(312) J. H. C., Crawfordsville, Ind., asks: Please give me a rule for finding the position of a safety valve weight, to enable the valve to blow off at a given pressure. For instance, the valve is 2 inches in diameter; weight of valve and stem is 5 pounds, fulcrum at 4 inches from the valve; weight of lever is 12 pounds; weight of ball 60 pounds; steam to blow off at 50 pounds. How far from the fulcrum shall I place the weight? *A.*—We cannot work out your problem accurately, for the simple reason, that you have not given the length of the safety valve lever, and its shape. But leaving the weight of the lever out of the calculation (which we are compelled to do, not knowing its length and shape), you may find the distance between the center of the weight and fulcrum in the following manner: Multiply the area of the valve in square inches by the pressure per square inch, thus: the area of a valve 2 inches in diameter is 3.1416 square inches, and $3.1416 \times 50 = 157.08$ pounds, which is the total pressure on the valve when it is to blow-off. The weight of the valve and stem is 5 pounds, hence $157.08 - 5 = 152.08$ pounds, which is the steam pressure which the weight or ball must resist. Multiply this pressure by the distance between the fulcrum and the center of the valve, and divide the product by the weight of the ball; the quotient will be the distance required. Hence we have $152.08 \times 4 = 608.32$ and $608.32 \div 60 = 10.12$, say 10¼ inches, which is the distance between the center of the ball and the fulcrum. Of course, if the weight of the lever had been taken into account, this distance would have been less. For rules relating to safety valve problems see AMERICAN MACHINIST, Dec. 6, p 2, 1884 2. In a battery of three or more boilers, all connected to one steam pipe and one feed pipe, is there any danger of water leaving boiler and rushing into the others? *A.*—See answer to Question 280, in our issue of June 2, 1888. 3. Are there any rules for calculating the pressure which a boiler will stand when the tensile strength and the thickness of the metal is known. *A.*—See Answer to Question 138, in our issue of March 26, 1887.

(313) J. H. B., Louisville, Ky., writes: Please answer to settle a discussion between us. A weight of 100 pounds falls 7 feet, please give striking force in pounds, and also the formula. My calculation is 4,600 pounds. The professor's is 22,000 pounds. State who is right. *A.* Judging from the statement of your question, both you and the professor seem to be laboring under a false idea; namely, that a body can be brought to rest instantaneously. No finite force could do this, but only an infinitely great one, and therefore we may say that it is impossible that any moving body should be instantaneously brought to rest. If the retarding force be very great, the time required for the stoppage may be very small, but no force whatever, short of an infinitely great one, can reduce the time to absolute zero, that is, can make the stoppage absolutely instantaneous. We will now put the question so that it can be answered, thus: A weight of 100 pounds falls 7 feet on a hot piece of iron which it compresses. The duration of the blow that is, of compression, is half a second. What is the average compressive force during that time? The velocity of the weight when it strikes the iron is equal to the square root of the product obtained by multiplying the 7 feet by 32 2 and by 2 (32.2 is the acceleration due to gravity, that is 32.2 foot seconds per second). Hence the velocity is equal to

$$\sqrt{7 \times 32.2 \times 2} = 21.2$$

feet per second. The mass of the body is equal to the quotient obtained by dividing the weight of the body by 32.2, hence we have

$$\frac{100}{32.2} = 3.1 \text{ units.}$$

Its momentum when it strikes the iron is equal to the product of the mass into its velocity. Hence we have $3.1 \times 21.2 = 65.72$, which is numerically equal to the impulse of force multiplied by time. The required mean force is therefore equal to

$$\frac{65.72}{0.5} = 131.4 \text{ pounds.}$$

Had the iron been cold in the example just given, so that it would not have "given" appreciably under the blow, the time of contact would have been much shorter, and the force or pressure of the blow very much greater, and, on the other hand, if the material had been softer, and allowed the blow to last longer, its force would have been correspondingly less. The mass is the fixed quantity, and its velocity has some maximum value in each case, so that the momentum of a falling or striking body cannot exceed some determinable value. But the actual pressure which the falling body exerts against whatever is below it—which is what is generally meant by the force of the blow—will depend on the duration of contact, and this will obviously depend on the hardness or compressibility of the material struck. This subject is thoroughly explained in Mechanics of Machinery by A. B. W. Kennedy, from which these remarks have been taken. 2. Stanley's rule No. 4, single joint, has the letters M and E on the face of it. Please give the meaning of these letters, and what are they used for? *A.*—M stands for middle or center line; and E stands for edge. The graduated spaces to which these letters are attached are used for laying out a post which is to have eight equal sides, thus: The post is first made perfectly square, and say it is 4 inches square. From all the edges of the post lay off points, whose distance from the edge are equal to the distance from the end of the rule to the division marked 4 on the scale to which the letter E is attached, and through these points draw lines parallel to the edges of the post, and then cut off the corners of the post to these lines. If the post is only two inches square, then the distance between the edges of the square post and the lines indicating the corners of eight-sided posts will be equal to the distance from the end of the rule to the division marked 2 on the scale E. The scale marked M is used for laying out on a square post the edges of the octagon or eight-sided post from the center line drawn on the side of the post; and is used in a manner precisely similar to the former method.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

See Grant's Gear advt. on back page.

Link-Belting.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link Belt in use.
Link Belt Machinery Co., Chicago and N. Y.

Taper attachment on all lathes Lodge, Davis & Co.
Compound rest on all lathes Lodge, Davis & Co.
Power cross-feed on all lathes Lodge, Davis & Co.
Large hollow spindle on all lathes Lodge, Davis & Co.
Automatic stop on all lathes Lodge, Davis & Co.
See special ads. pages 15 and 16 Lodge, Davis & Co.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee Falls, Mass

Machine work and pattern making. Anderson Machine Works, Peekskill, N. Y.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

Drop presses, punches and shears. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Improved fine tools for mechanics, manf'd by L. S. Starrett, Athol, Mass. Send stamp for full list.

"Swift" Sight-feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Castings for small and medium sized vertical engines. Humphrey's Foundry, Bellefontaine, O.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Burnham's turbine wheel is sold at net price to mill owners. Catalogue free. Address York, Pa.

Selden packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Brown & Sharpe Mfg. Co. have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

Patents—Whittlesey & Wright, 705 8th st. N. W., Washington, D.C. Send for pamphlet and references.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago. Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 W. 13th st., New York.

Model Engines and Castings. Prices $3.75, $4.75 and $5.75. For descriptive circular apply to Montgomery & Co., 105 Fulton street, New York city.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See June 9, p. 10. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Machinists' supplies, brass goods, m'f'rs supplies polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

Patent Att'y. R. G. DuBois, 916 F. st., Washington, D. C. Reliable service at reasonable rates. Send for 38-page pamphlet containing list of references.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Parties requiring milling machine or screw machine work furnished, in large or small quantities, please write to the manufacturers, E. E. Garvin & Co., 139, 141, 143 Centre st., New York City.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing gray iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

A practical treatise on the steam engine, by Arthur Rigg, essays on the principles involved in design and construction of fixed engines; 312 pages, with 96 plates. 4to, cloth, $10.00. E. & F. N. Spon, 12 Cortlandt st., N. Y.

For the manufacture of
Patented articles in line of machine work;
Specialties in fine light machinery;
Accurate cam cutting;
Address Wardwell S. M. Co., Woonsocket, R. I.

James D. Cardell & Co., 1900 Passyunk ave., Phila., Pa., boiler makers and sheet iron workers, m'f'rs of coils of wrought-iron pipe, return bends, etc. Address after June 15, Rising Sun Lane and North Penn. R. R. Boiler repairs promptly attended to.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including June 2, 1888 issue, 51 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 65 articles have thus far appeared up to and including the May 26, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES

W. O. McComac will build a planing mill at Atalla, Ala.

A planing mill will be built at Talladega, Ala., by Farrar & Higgins.

Huffman Bros. contemplate building a saw mill at Williamsburg, Ky.

The Thomasville wagon factory will erect works at Choctaw Corner, Ala.

J. B. Read is interested in building a sash and blind factory at Decatur, Ala.

Enderlin & Beronir will place more tools in their machine shop at Aberdeen, Miss.

U. C. Williams & Co. will build a planing, shingle, lathe and stave mill at Duke, Ga.

William Farrell will put a new engine in his planing mill at Wrightsville, Ark.

The Perry Stove Works, recently burned at South Pittsburgh, Tenn., will be rebuilt.

Steam power will be put in the wagon factory of J. A. Martin & Co., at Powhatan, Ark.

Taft & Morgan's sash and door factory, at Burlington, Vt., was lately destroyed by fire.

The Clipper Mowing Machine Works of Keene, N. H., have recently filled large orders from France.

E. C. Stearns & Co., Syracuse, N. Y., have improved their bench drill by adding an adjustable table.

The West Point (Ga.) Manufacturing Company will add considerable machinery to their cotton factory.

The Paducah (Ky.) Land, Iron and Coal Company are interested in building an iron furnace and pipe works.

The Little Rock (Ark.) Dummy Railroad Company has begun building a machine shop at Little Rock, Ark.

The Dallas Electric Light, Power and Manufacturing Company will enlarge their electric light plant at Dallas, Texas.

The Florida Railway and Navigation Company will build new machine shops at Fernandina, Fla. Work is reported to be commenced soon.

A. T. Wing & Son, Oldtown, Me., have leased a large building, in which they will place machinery for manufacturing house finishing material.

The grading for the Anniston and Cincinnati railroad shops, at Anniston, Ala., is completed, and the erection of the shops will be begun at once.

The Stiles & Parker Press Company, Middletown, Conn., have recently added 150 feet to their factory, making floor room 350 feet long. They are making still another addition, rendered necessary by increase in orders.

The Berlin Machine Works will remove from Berlin to Beloit, Wis. They will occupy the plant formerly occupied by the O. E. Merrill Machine Shops. The citizens of Beloit contribute $9,000 towards the removal.

The Wootten engine has recently been put in competition on the P. R. R. with the ordinary coal burner. The Wootten engine uses a cheap quality of coal—buckwheat—and the relative cost of fuel was materially in favor of the Wootten engine.

The Atlas Paper Mill at Appleby, Wis., owned by a stock company controlled by the Kimberly Clark Company, was totally destroyed by fire recently. The fire is supposed to have started in the vicinity of the boiler. Loss $150,000.

Lloyd, Booth & Co., of the Falcon Foundry and Machine Works, Youngstown, Ohio, are building an important addition to their works. When completed, the works will be equipped with six traveling cranes, and many improved tools and machines.

The Pulsometer Steam Pump Company, New York, send us a framed illustration in relief of their new pulsometer. The illustration is built up and gilded, showing the parts exactly as they appear to the eye. It is a novel and striking illustration of the subject.

The firm of Bigelow & Co., composed of Alanson Bigelow, jr., and John J. Caldwell, of Plymouth, (Mass.) has leased the plant of the Standish Mills in that city, where they purpose continuing the business of the old firm, manufacturing woolen yarns, merino yarns, and woolen spun cotton yarns in solid colors and fancy mixes.

The Brown & Sharpe Manufacturing Company have printed, for general circulation, a small pamphlet, in which they discuss their standard gears, as made for the trade. The argument of this little circular is worth the attention of every machinist who uses cut gears. No one can read it without gaining some information.

The Hall Manufacturing Company, Philadelphia, Pa., has brought out a new paint mill in which four runners are used under one hopper. The construction is such that the hopper can be divided so as to grind four colors at once, or the four runners or mills may work on a single color. The runners have cast-steel faces top and bottom.

William Swindell & Bros. [Pittsburgh, Pa.], have just completed and put in operation one of their improved natural gas double puddling furnaces for Oliver Bros. & Phillips. This furnace will make at one heat the same as two single furnaces, and will run with less gas than one single furnace. They have also put in operation another of their large natural gas heating furnaces for the same firm. They have just finished for Oliver & Roberts Wire Company, for their rod mill, one of their natural gas regenerative furnaces. This firm have also just completed one enameling furnace for the Standard Manufacturing Company.

The Pratt & Whitney Company, Hartford, Conn., write us: It may be of interest to your readers that the late fire in the establishment of C. H. DeLamater & Co., foot 13th street, New York, has interfered seriously with their work, and made it very inconvenient for them to continue the manufacture of the Double Spiral Lip Punches and Punching Machines, patented by D. L. Kennedy, New York, and that, upon their suggestion, the Pratt & Whitney Company, Hartford, Conn., has bought out the business and will hereafter make the punches as sole manufacturers under an arrangement with the patentee. A goodly assortment of the tools are now ready for delivery, not having been damaged by fire, and such as are not in stock, and special styles, can very soon be made by the latter company.

The *Pacific Lumberman and Contractor* (San Francisco, Cal.) says: "The electric machinery for the Big Bend Tunnel is being put up. It comprises two dynamos, 12 motors, 50,000 pounds of copper wire, and a large lot of different kinds of machinery. The dynamos have a capacity of 140 horse-power, and the motors 5 horse-power each. There are two lines of copper wire, one seven miles long and the other ten, and as each is double, this makes about 34 miles of wire. The electric power will be used to run the pumps and derricks. The plant was furnished by the Sprague Electric Railway and Motor Co., of New York city. A force of men is now engaged in getting everything ready for the immense plant. Three hundred inches of water, with a fall of 300 feet, will furnish the necessary power to run the dynamos.

Negotiations have been concluded that insure the establishment of large iron and steel works in the Puget Sound county, W. T. The works will be built by Peter Kirk, of the Moss Bay Hematite Iron and Steel Company of Workington, England. For this purpose he has purchased 2,500 acres of land on the eastern side of Lake Washington, and the work of preparing this site has already begun. The western shore of the lake forms the eastern boundary of the city of Seattle, and the distance from the city to the works across the lake is about four miles. The site of the works has been named Kirkland. The capital of the New Moss Bay Company is $5,000,000, all of which has been taken in England. The new works are expected to employ 2,000 to 3,000 men. There are unlimited quantities of Bessemer ore, said to be equal in quantity to the best Lake Superior ores in the Snoqualime Pass, near the summit of the Cascade range, and other needed articles are within easy reach. This is the first attempt at steel-making from the raw materials on the Pacific coast.

The Williston yarn mills, East Hampton [Mass.] comprising two factories and about 31,000 spindles, have been purchased by George H. Seelye, of New York, Henry S. Seelye, treasurer of the Worcester street railroad, George F. Mellen and Reuben Hargraves, of Fall River. The mills are driven by steam and water power, and the machinery is in excellent condition. Wherever it is run down the old will be taken out and replaced by new, and under an entire change of management will continue to produce the fine high grades yarns for which a reputation is already established and a market made. The purchase also includes 150 acres of land and 100 houses; in fact, pretty much all the pretty and attractive little village. The price paid is not yet made public, but the purchasers are said to have secured an excellent bargain. A new corporation has been formed with the gentlemen already mentioned and C. C. Pratt, president of the First National Bank of Worcester, and of the Worcester street railway, as directors, Mr. Pratt having been admitted to the syndicate purchasing the property. The five gentlemen named are the sole stockholders in the new concern.—*The Commercial Bulletin.*

Machinists' Supplies and Iron.

New York, June 14, 1888.

Iron—American Pig—We quote Standard Lehigh brands $18 to $18.50 for No. 1 X Foundry, the outside quotations being for small lots; $17 to $17.50 for No. 2, and $15.75 to $16.25 for Grey Forge. Outside brands are cheaper, but irregular and difficult to quote.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to examine S. S. planes; see p 11.

Position wanted by exp. mech'l draftsman; graduate from tech. school; Swede; 26; Am. Machinist.

Wanted—Competent machinists on lathes and planers. The Pond Machine Tool Co., Grant ave., Plainfield, N. J.

A first-class draftsman and designer, with eight years' experience, is open for engagement. Address Box 103, Am. Machinist.

Englishman wants charge of machine shop; well up in tools and management of men; good references. C. H., Am. Machinist.

Wanted—Foreman, American, for brass foundry; thirty furnaces; must thoroughly understand mixing of metals and be capable of handling men. H. W., Am. Machinist.

Wanted—A thorough and practical machinist to take charge of machine shop; must be well posted on saw mills and general job work. Address Okey K. Cole, Parkersburg, W. Va.

Contractor wanted on machine construction work; a reliable, prompt, capable workman, who can handle a gang of men, can find a good opening. Address A. Y., Am. Machinist.

Wanted—A smart, ingenious mechanic, who understands working small tools, drills, millers, etc.; salary $2 50 per day; young man preferred. Address "A," Letter Carrier 31, Buffalo, N. Y.

Wanted—In the interior of Pennsylvania, for about two months, a draftsman familiar with locomotive work. Address, stating experience and salary expected, O. B., P. O. Box 262, New York City

Wanted—A first-class draftsman, experienced in machine tools for machine shop and railroad use; none but competent, first-class men need apply; state experience, age, and wages required, to Box 101, Am. Machinist.

Wanted—Position by experienced designer and draftsman, with extensive and varied practice in steam engine, locomotive and mining work. Colorado or other Western State preferred. Address John Ives, Box 8, Trinidad, Col.

Wanted—By a thoroughly successful superintendent of machine shop and foundry, and practical machinist of twenty years' experience, a change after Aug. 1, 1888; now has entire management of plant of 100 men in New England; best of reference; would accept situation as superintendent or as foreman of machine shop at reasonable figures George H., Am. Machinist.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head a 35 cents per line, each insertion.

Crescent solid lubricant, clean, durable, cheap; prevents hot boxes. Crescent Mfg. Co., Cleveland

The Crescent automatic grease cup is adapted to every service. Crescent Mfg. Co., Cleveland, Ohio.

Wanted – Parties having machinery specialties to build, to correspond with. Box 75, Am. Machinist.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Correspondence solicited with parties having machine or foundry specialties to build. Honesdale Iron Works, Honesdale, Pa.

We want to buy a 5 foot x 24 x 24 to 8 foot x 30 x 30 planer; second-hand; must be a good modern tool. Address with full description, Price & Tillinghast, Renfrew, Pa.

August C. Christensen, M. Am. S. M. E., 24 State st. (Battery), N. Y.; 463 Henry st., Brooklyn. Working drawings and superintending the building of machinery; steam, pun ping and gas engines indicated.

For sale, at less than half its value, a brick foundry and machine shop doing a good business; well located; machinery and property in good repair; will sell for $8,000; ⅓ cash, ⅓ in 9, and ⅓ in 18 months, with interest at 6 per cent.; property is actually worth over twice the price asked. For particulars address A. J. Ross, Peru, Ind.

Ernest W. Naylor, consulting engineer and draftsman, plans and estimates for all kinds of hydraulic flanging, bending, forging, and other presses; hydraulic shearing and punching machines, jacks, capstans, cranes, hoists, lock gate and sluice machines; Bessemer and steel plant ingot cranes; center cranes, blowing and rail mill engines, etc. etc.; fixed and portable hydraulic riveting plant; pumping engines and accumulators, etc., etc. Offices J. & K., 149 Broadway and Liberty st., N.Y.

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W. C. YOUNG & CO., Worcester, Mass. Manufacturers of
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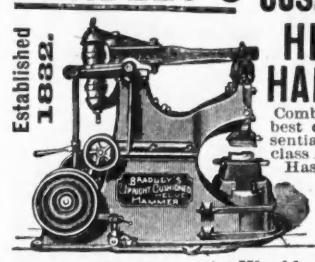

Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other Hammer in the World.

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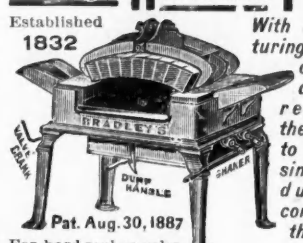

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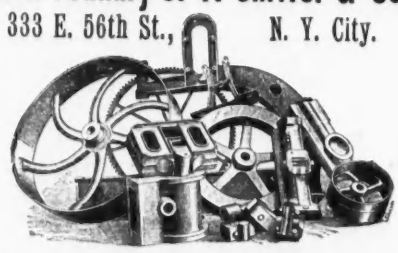

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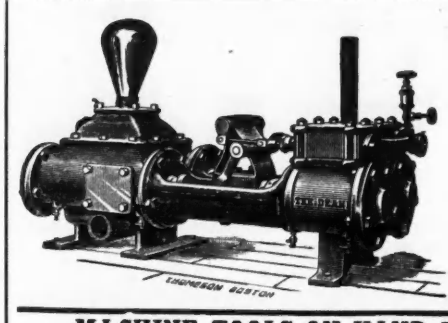

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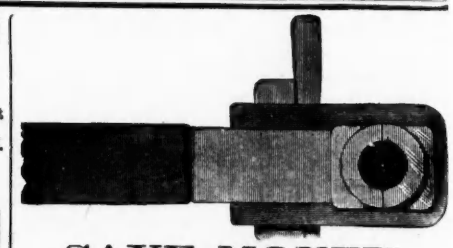

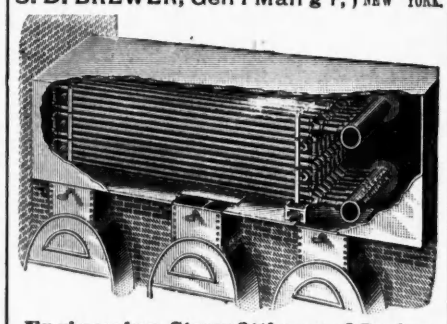

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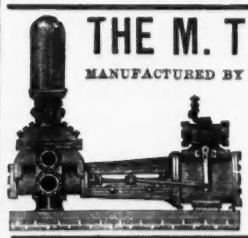

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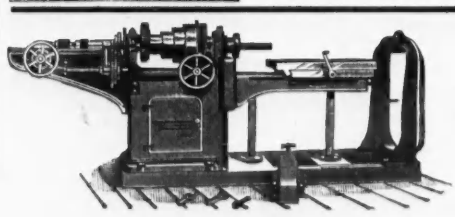

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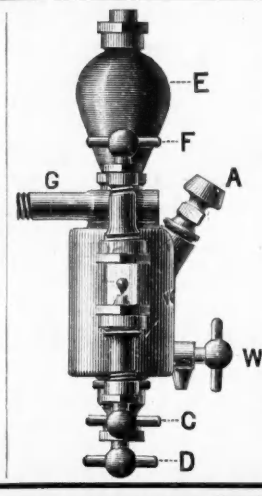

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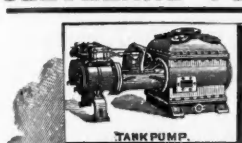

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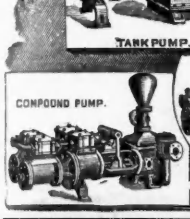

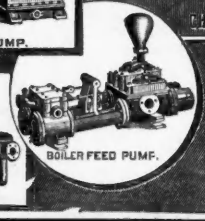

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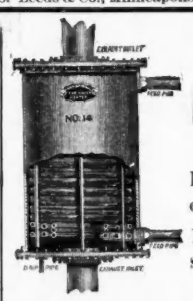

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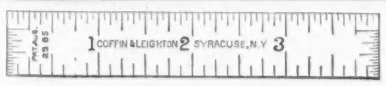

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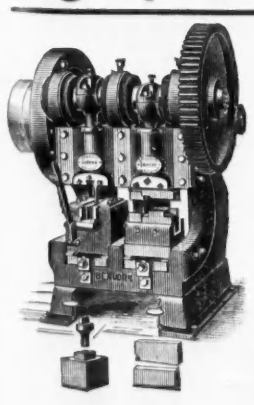

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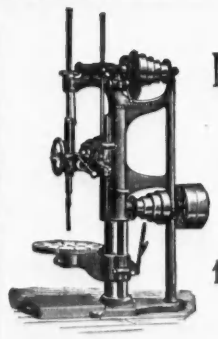

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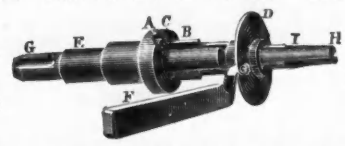

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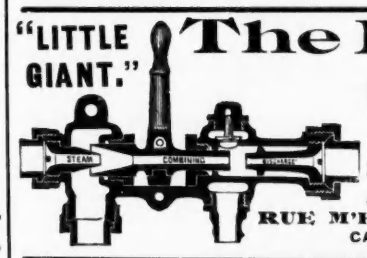

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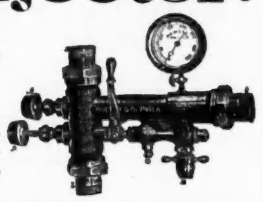

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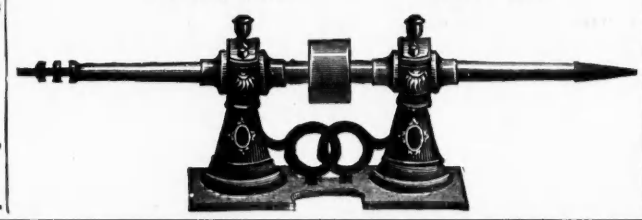

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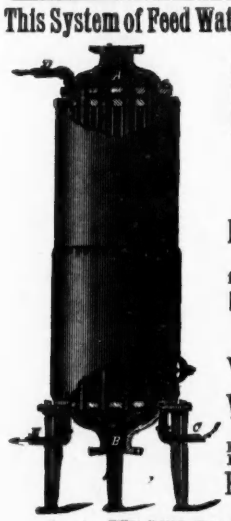

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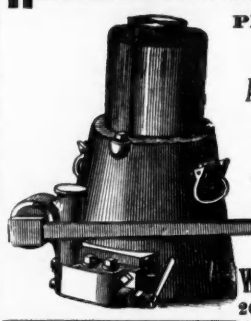

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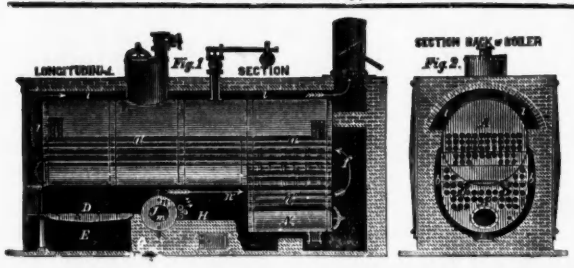

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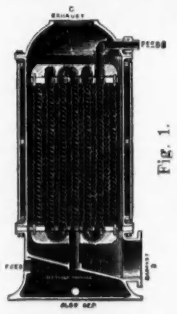

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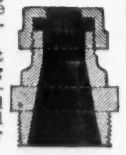

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18 "	19¼ "
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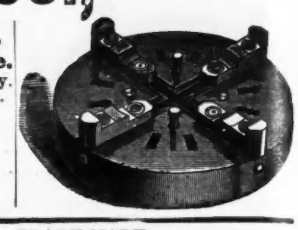

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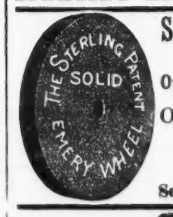

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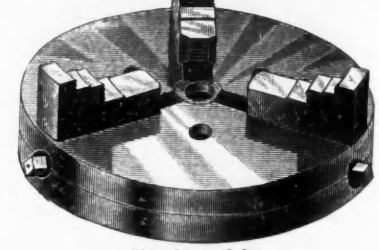

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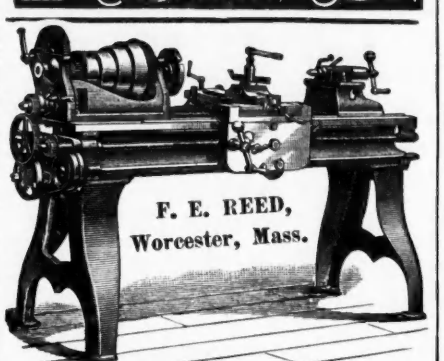

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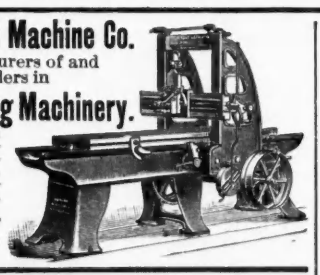

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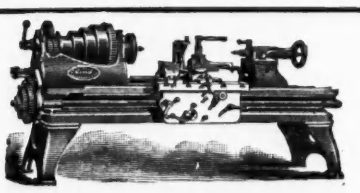

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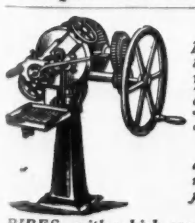

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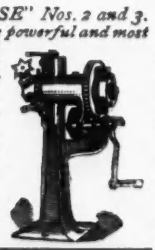

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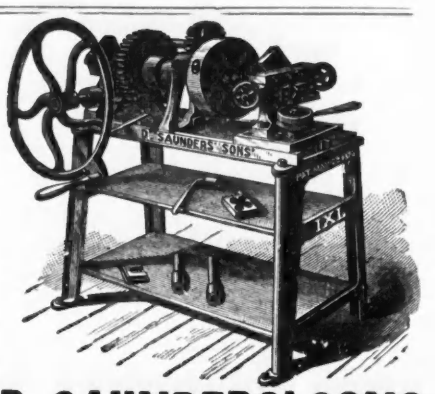

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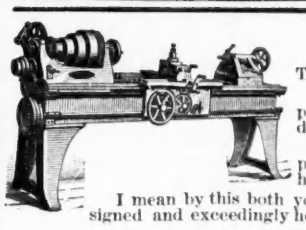

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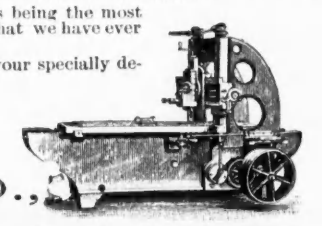

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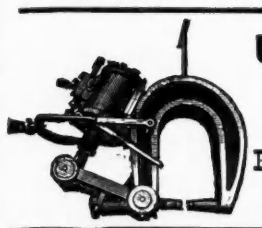

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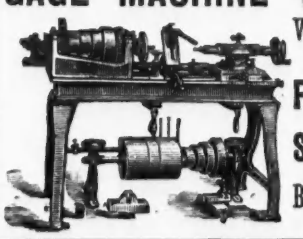

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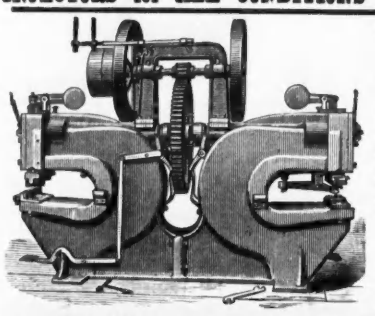

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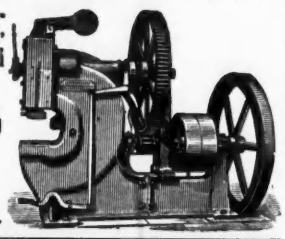

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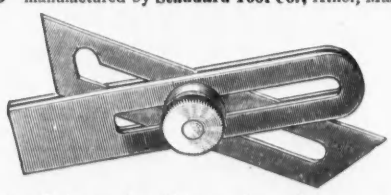

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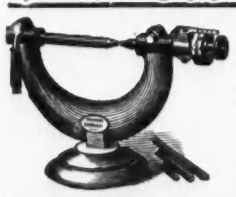

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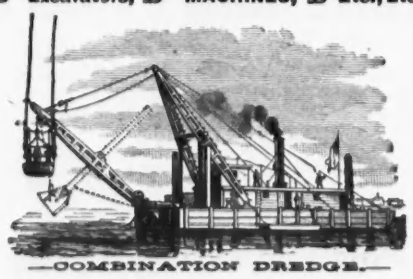

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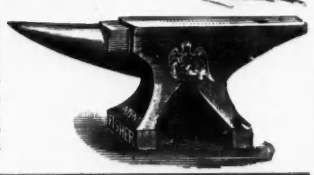

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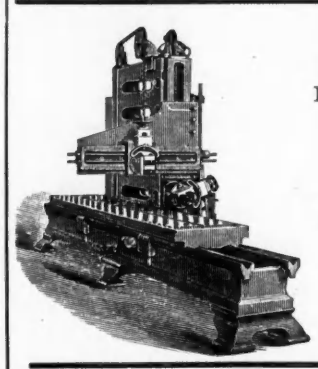

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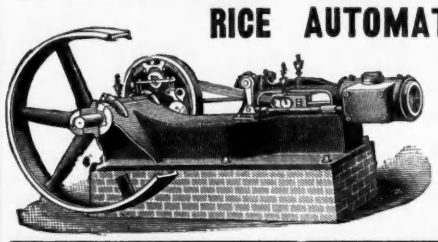

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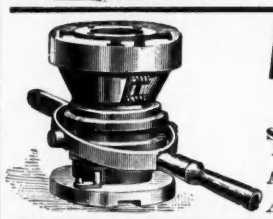

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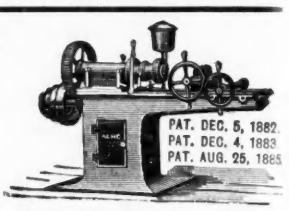

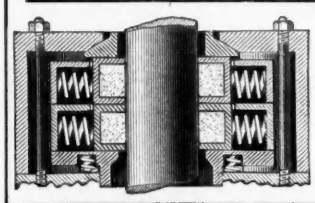

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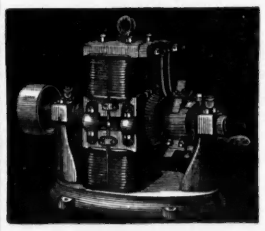

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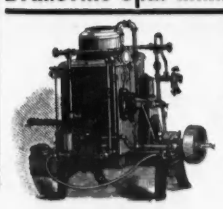

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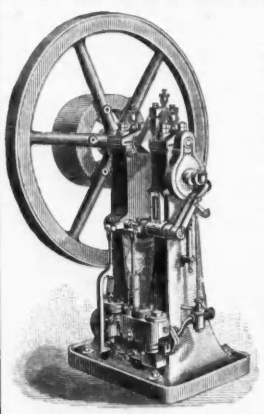

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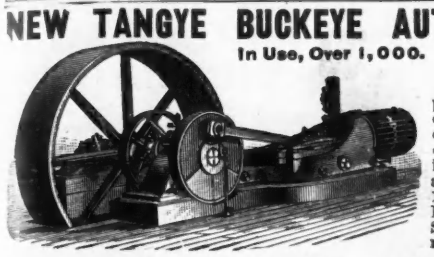

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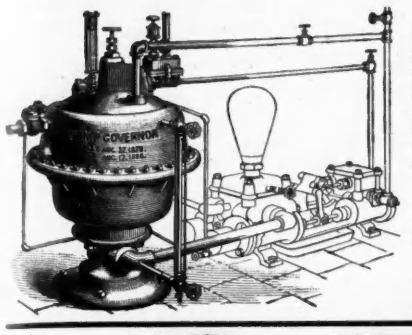

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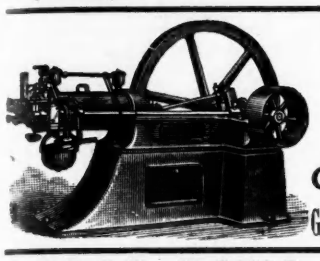

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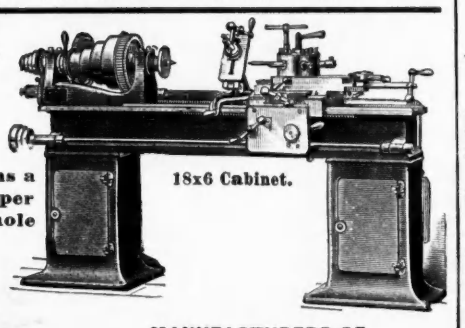

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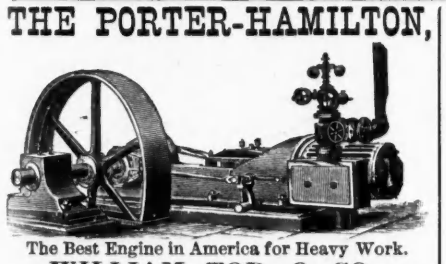

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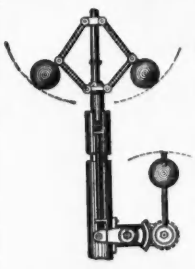

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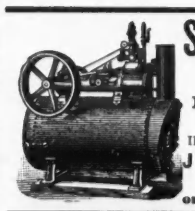

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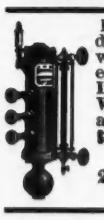

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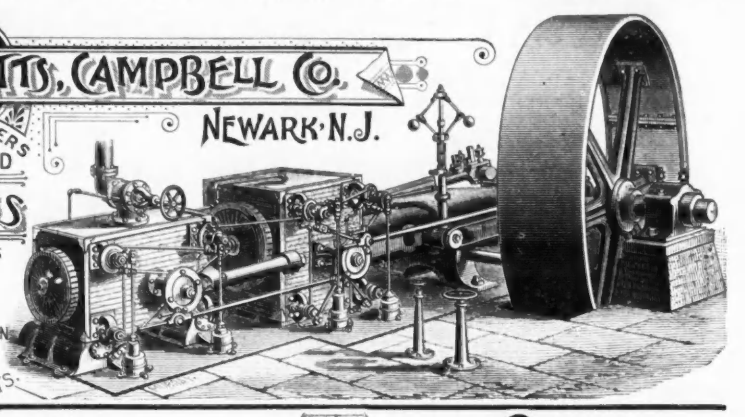

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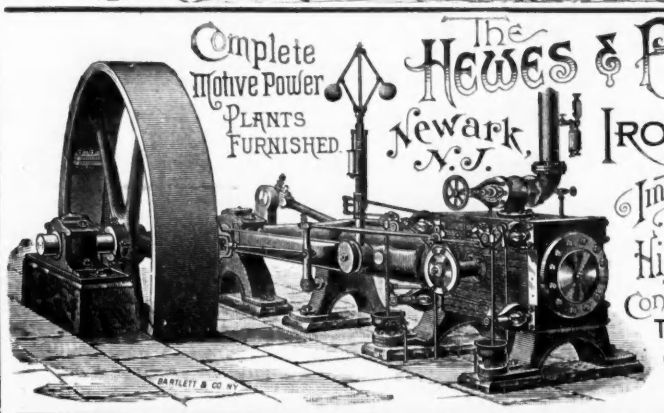

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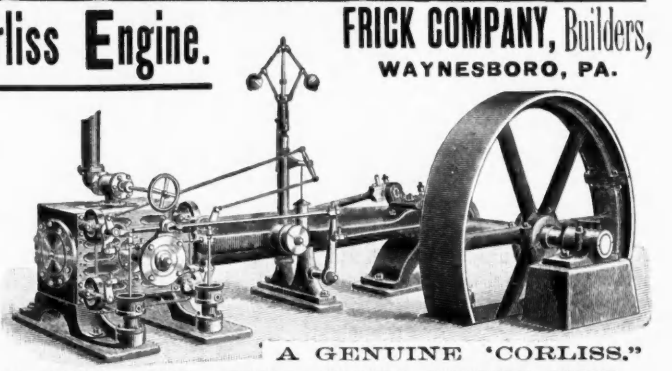

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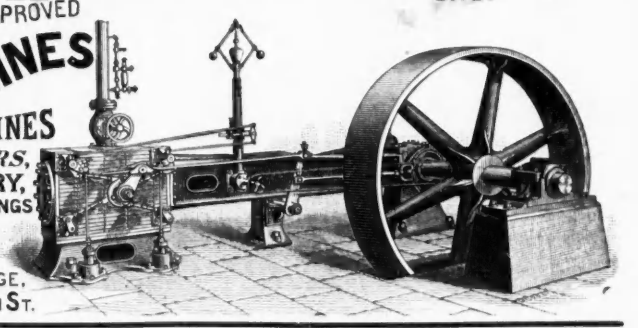

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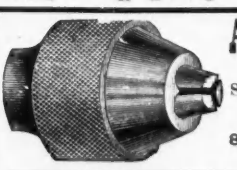

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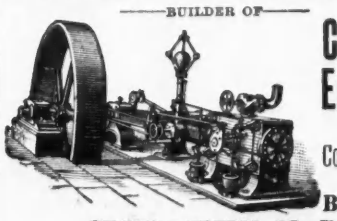

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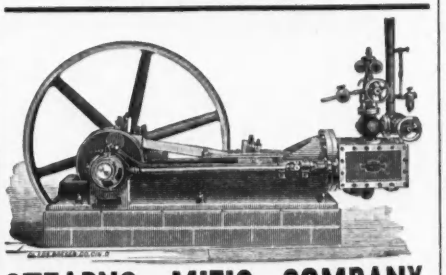

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24 in. Swing	22 ft.	Bed	Shafting Lathe,		Providence.
36 " "	12 "	"	Engine	"	Putnam.
33 " "	12 "	"	"	"	Portland Co.
18 " "	9 "	"	"	"	Star.
18 " "	8 "	"	"	"	Flather.
18 " "	7 "	"	"	"	D. W. Pond.
17 " "	5½ "	"	"	"	Shepard.
15 " "	6 "	"	"	"	Fitchburg.
12 " "	5 "	"	"	"	Prentice.

Putnam Gap Chucking Lathe, 60 in. swing, 9 ft. bed.
Monitor Brass Lathe, 18 in. swing, 5 ft. bed.
Wheeler Planer, planes 22 in. wide, 4 ft. long.

Providence	"	"	24 "	5 "	"
Hendey	"	"	26 "	6 "	"
Bement	"	"	30 "	8 "	"

Hendey Shaper. 24 in. stroke. Fine condition.
Wiley and Russell Bolt Cutter No. 5, cuts ⅜ to 1¼"
Brainard No. 7 Milling Machine with Vise.
Brainard Gear Cutter, 30 in. Automatic Feed.
" " " 18 " " "
Garvin No. 2 Gang Drill, 2 spindles.
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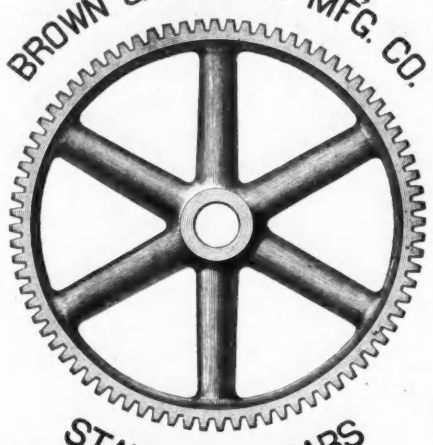

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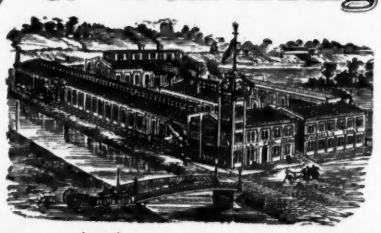

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ENGINE LATHES,
Upright Drill Presses,
SPECIAL PULLEY TURNING LATHES,
Special Pulley Boring Machines, &c., &c.

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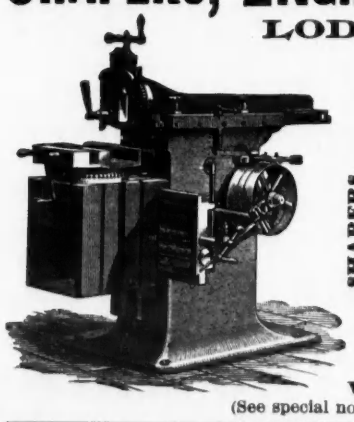

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ENGINE LATHES, 17", 19", 21", 24", 27".

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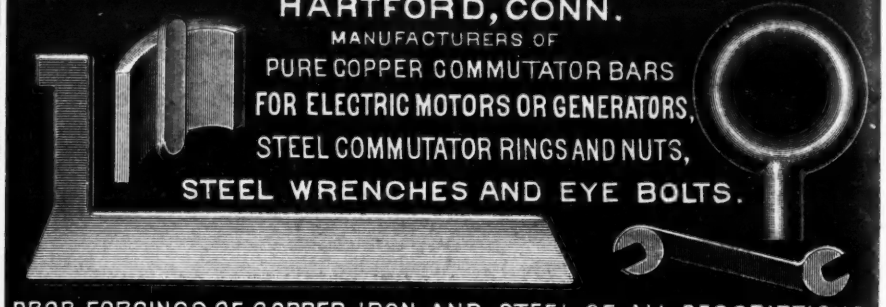

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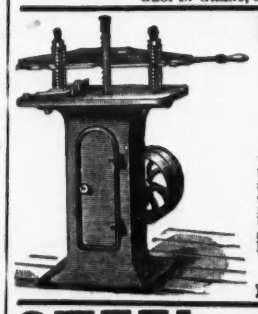

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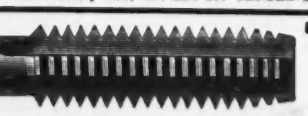

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